International Marine Engineering

Published Monthly by ALDRICH PUBLISHING CO.

17 BATTERY PLACE, NEW YORK — 31 CHRISTOPHER ST., LONDON, E. C.

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Vol. XIX — JULY, 1914 — No. 7

The New Cunard Express Liner Aquitania

Decription of the Hull and Machinery of the Latest Addition to the Famous Cunard Fleet

The new Cunard Liner *Aquitania*, built by John Brown & Company, Ltd., Clydebank, arrived in New York, June 5, on her maiden voyage. The voyage from Liverpool to Ambrose Channel Lightship, a distance of 3,181 nautical miles, was made at an average speed of 23.1 knots. Surpassing the previous Cunard express steamers *Lusitania* and *Mauretania* in every particular except speed, the *Aquitania* is 901 feet long overall; 97 feet beam with a molded depth of 64 feet 6 inches. With a displacement of 49,430 tons, the vessel draws 34 feet of water, the weights being distributed approximately: Hull, 29,150 tons; machinery, 9,000 tons; bunker capacity, 6,000 tons; total deadweight capacity, 11,280 tons. According to approximate measurements, the gross tonnage is 46,150 and the net tonnage, 17,500. Accommodations are provided for 618 first class, 614 second class, and 1,998 third class passengers, making a total of 3,230 passengers, which, with a crew of 972, brings the total number of persons provided for on board the ship up to 4,202.

Every important detail of this magnificent ship is fully described in a comprehensive and fully illustrated article published in ENGINEERING, May 8, 15, 22 and 29, to which we are indebted for many of the machinery details given below and for the drawings reproduced herewith.

HULL CONSTRUCTION

From bow to stern there is a double bottom, which has a depth of 5 feet 4 inches, increased to 6 feet 3 inches in the turbine room. In all there are 41 watertight compartments in

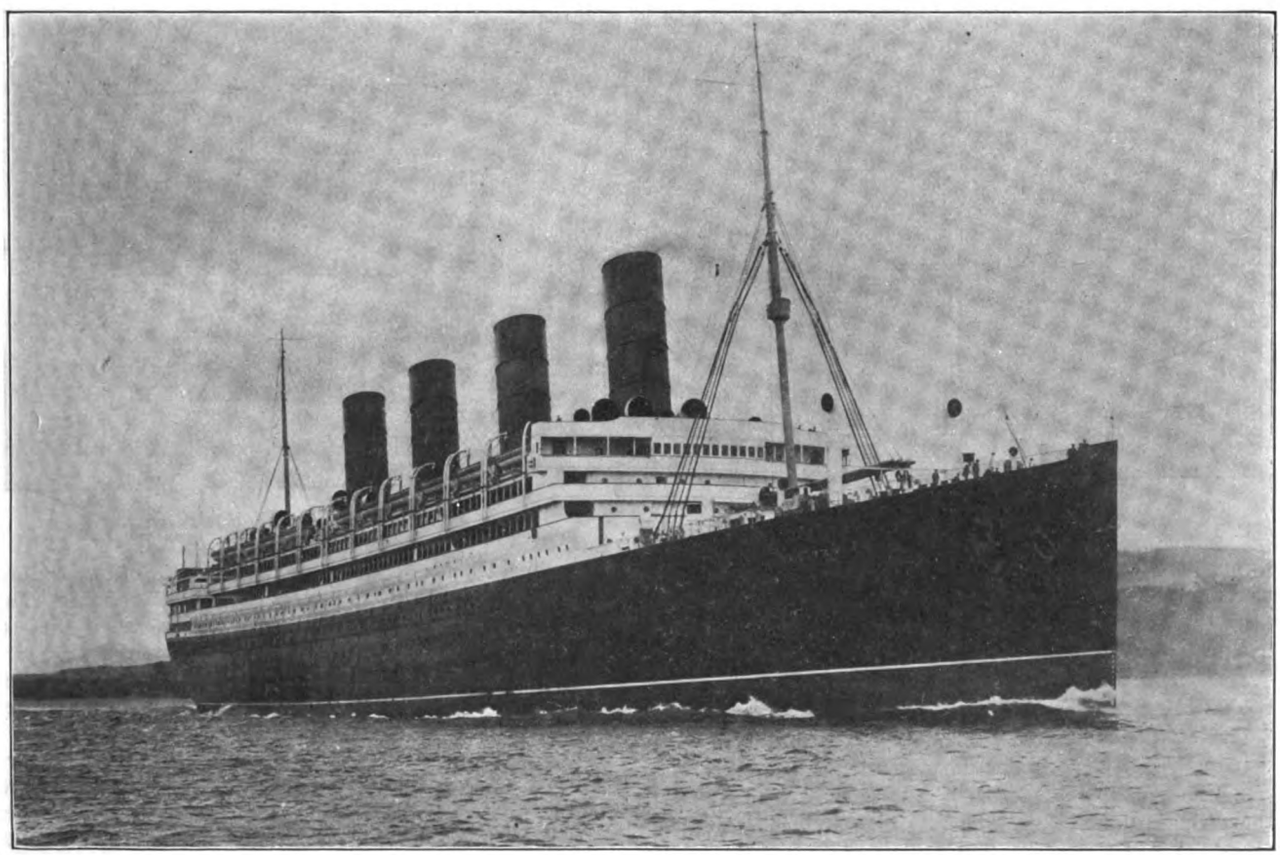

Fig. 1.—New Cunard Liner *Aquitania*, Built by John Brown & Co., Ltd., Clydebank

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the double bottom, each of which can be pumped out or filled separately. Five of the fore-and-aft girders are watertight and there are further six longitudinal intercostal girders, composed of 12/20 inch plates. The center keelson is built up of 21/20 inch plates, with double angles at top and bottom, secured to a flat keel made up of three plates of a collective thickness of 3½ inches. The seven longitudinals on each side of this center girder are 12/20 inch thick.

The frames above the margin plates are steel channels. Web frames, 36 inches deep, are introduced at every third frame throughout the greater part of the length of the ship, but closer where required, notably in the machinery space. All these extend at least to the deck 10 feet above the load waterline, and some to decks above this level.

The shell plating is 23/20 inch thick amidships, the sheer strakes being doubled and riveted by hydraulic riveters.

The hull is divided into eighty-four compartments, in addition to the forty-one in the double bottom. There are sixteen transverse bulkheads, most of which extend 19 feet above the load waterline, while the others extend to 9 feet above the load waterline. The turbine room is divided into three compartments by two longitudinal bulkheads. Similarly, the condensing plant aft is divided into two units by a center line bulkhead. In order that the damage by collison at the point of junction of the transverse bulkhead in the machinery space with the shell plating should not affect two compartments a V-shaped connection has been made, so that damage at that point may be localized to one compartment only. The tunnel end of the condensing room is also divided into several compartments by the fresh water tanks.

There is a fore-and-aft bulkhead on each side of the space occupied by the boilers, extending a distance of 450 feet. The longitudinal bulkheads forming the inner walls of the bunkers are 18 feet from the outer skin of the ship. The space within the inner walls, constituting the boiler rooms, is thus 60 feet wide. In the coal-bunker space again there are fitted partial transverse bulkheads dividing these bunkers into ten watertight cellular sections on each side, varying from 27 feet to 33 feet in length.

The hatches to the cargo holds are trunked and made watertight to the weather deck. The engine and boiler casings are extra well stiffened by webs and made watertight to 20 feet above the load waterline. This, in conjunction with the making of the decks watertight, will localize the volume which may, owing to accident, be flooded.

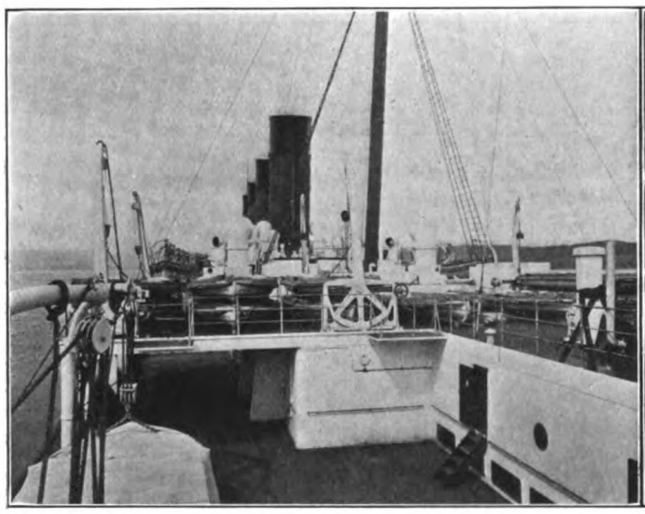

Fig. 2.—Boat Deck

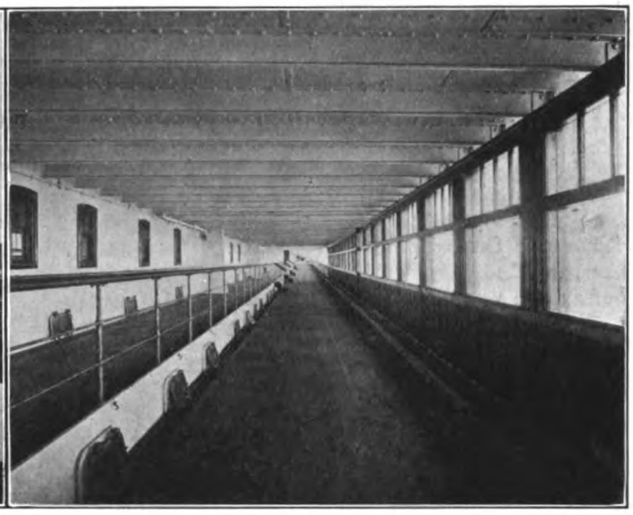

Fig. 3.—Promenade Deck

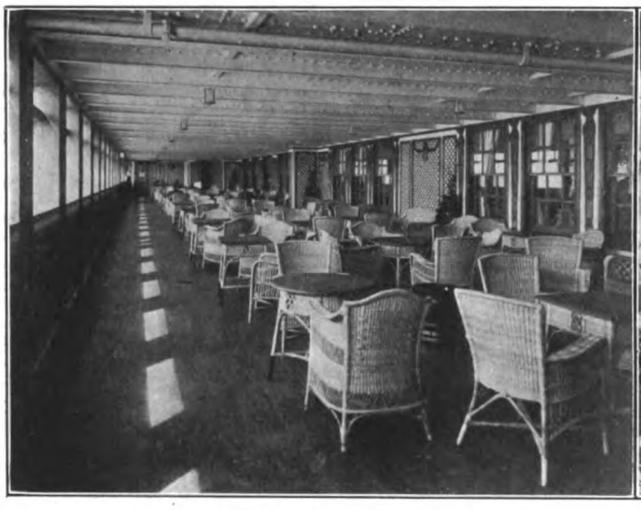

Fig. 4.—Garden Lounge

Fig. 5.—First Class Dining Saloon

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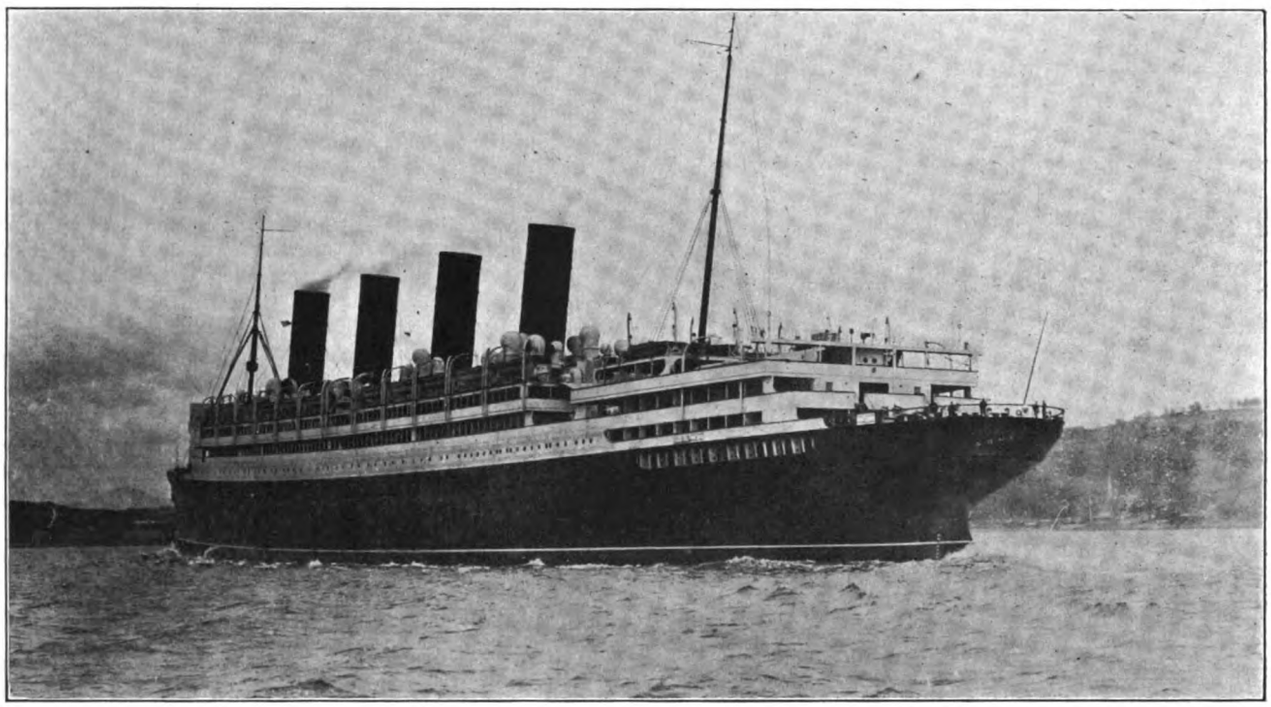

Fig. 6.—Stern View of the *Aquitania*

The main transverse bulkheads are of 12/20 inch plating stiffened by 12-inch channels space 2 feet 6 inches apart, and at intervals there are introduced vertical web stiffeners 3 feet deep, formed of 10/20 inch plates and double angles. In line with the two intercostal girders between the web frames at two points in the height of these vertical members, already mentioned, there are horizontal girders carried across the bulkheads at a level between the double bottom and "G" deck.

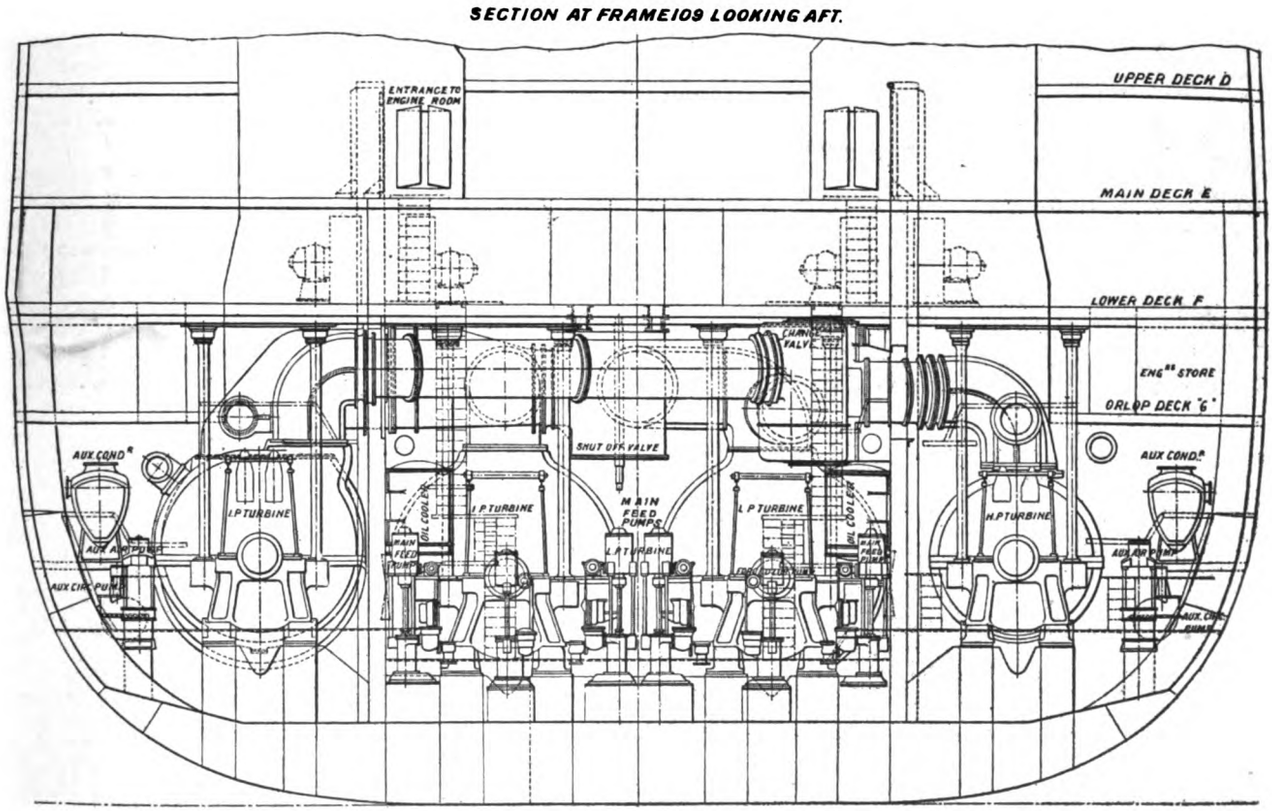

Fig. 7.—Section Through Turbine Rooms (Reproduced from *Engineering*)

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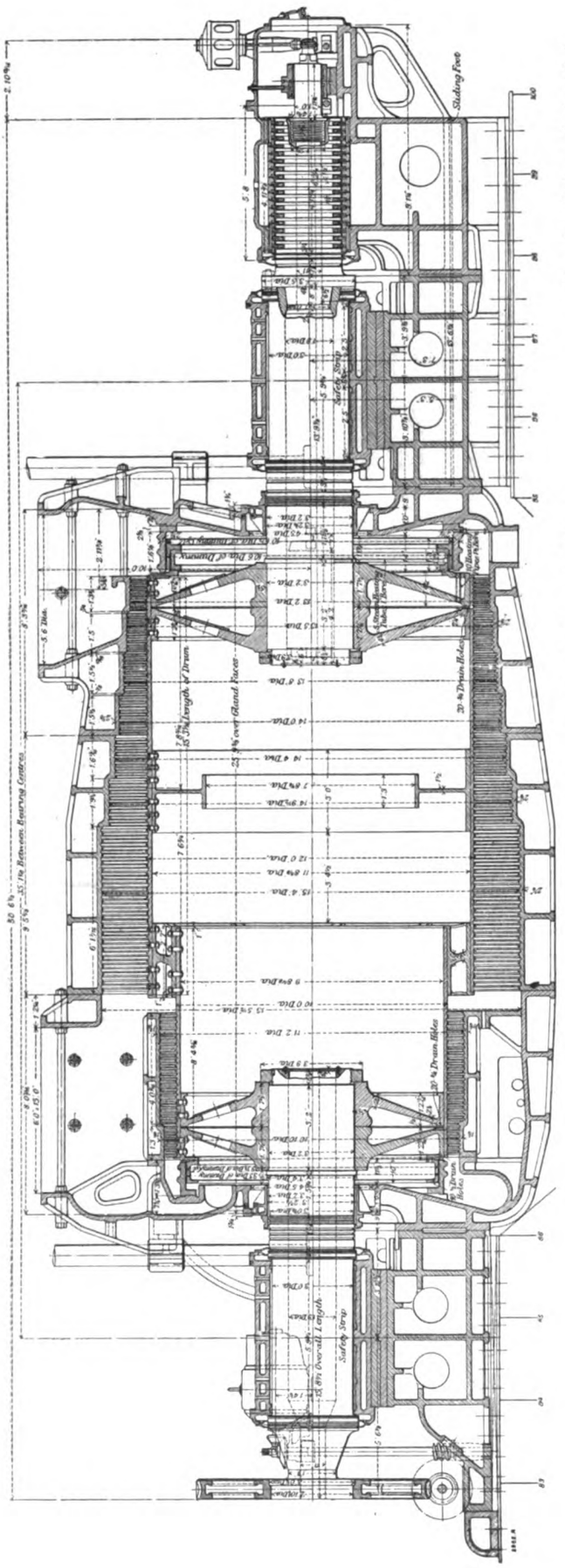

(Reproduced from *Engineering*)

Fig. 8.—Low Pressure Ahead and Astern Turbines

All the doors below and adjacent to the load line are of the sliding pattern and are fitted with Stone-Lloyd quick-closing gear.

The anti-rolling tanks take the place of one of the coal bunkers on each side of the ship.

The top strength deck, known as "B" deck, is 73 feet from the keel plate. The shell plating is doubled for a height of 12 feet at the gunwale, while the "B" deck is single plated. Below this level there are five complete decks extending fore and aft, and distant apart vertically from 8 feet to 11 feet, the greater height being on the deck where the first and second class dining saloons and some of the staterooms are located. At the ends of the ship, forward and abaft the machinery spaces, there is a partial deck, making six within the molded structure of the ship. These decks have beams at every frame, consisting of 10-inch channels. The thickness of the deck plating varies from ¾ inch to 1 inch. Special beams are fitted in the turbine compartments in order to carry the gear for raising and lowering the upper part of the casing and the rotor.

Above the molded structure of the ship there are two decks, designate the "A" deck and the boat deck. These extend 2 feet beyond each side of the molded structure, giving increased space for promenading, games and stowage of boats.

General Arrangement

There are nine decks in the *Aquitania,* in addition to the hold. Of these six are in the molded structure of the ship, while above there are three superstructure decks, the first extending for about 640 feet, the second for 624 feet, and the third, or boat deck, for about 464 feet in length amidships. Further aft, a deck house for the second class quarters is utilized for the carrying of additional boats on the same level as the boat deck proper. The total height from the keel to the boat-deck level is 94 feet.

On the boat deck accommodation is to be found at the forward end for the officers' quarters and mess room, and at the after end for men servants' mess room, as well as for the Marconi wireless telegraph office.

On the next deck, designated the "A" deck, the principal apartments arranged for are the first class drawing room, lounge, saloons, smoking room amidships, and a second class lounge further aft. The first class lounge and smoking room are connected by a long gallery. On either side of the first class lounge is a garden lounge.

On the "B" deck there are arranged many special staterooms, with one and two beds in each. The promenade extends all round the deck house, but is screened on each side at the forward end for a considerable length by extending the bulwarks up to the "A" deck, and fitting large sliding windows. In this way is formed a sheltered promenade. On the after end of the "B" deck there is the second class smoking room and drawing room, and the verandah café, outside of which there is extensive promenading space, and above which is a boat deck.

The "C" deck, which forms the top of the moded structure of the ship, is almost entirley given over to sleeping quarters. At the forward end of this deck there is space for windlasses, capstans, cargo hatches and cargo winches, and a house enclosing the entrance to the third class quarters on the decks below. The forward part of the deck affords a promenade for the third class passengers in fine weather. At the after end of the ship, also, there is space for working the ship with the necessary winches, capstans, and gear.

The first deck within the molded structure, designated the "D" deck, is given over largely to the cuisine department. In order to add to the comfort and simplify ventilation, the height between this and the deck above is 11 feet. The first class dining saloon is almost amidships, extending the full width of the ship. A foyer or reception room for the first class passengers is located forward of the first class dining

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saloon. The second class dining saloon is further aft. Between the two are the galleys. At the extreme after end of this deck there is a third class smoking room and entrance to the third class quarters, while at the forward end there is a large third class social hall.

fore and aft for the use of third class, or steerage, passengers.

On "F" deck are large dining saloons for the third class passengers, while the next deck, "G," is reserved entirely for third class passengers.

The seamen, firemen and trimmers are accommodated on

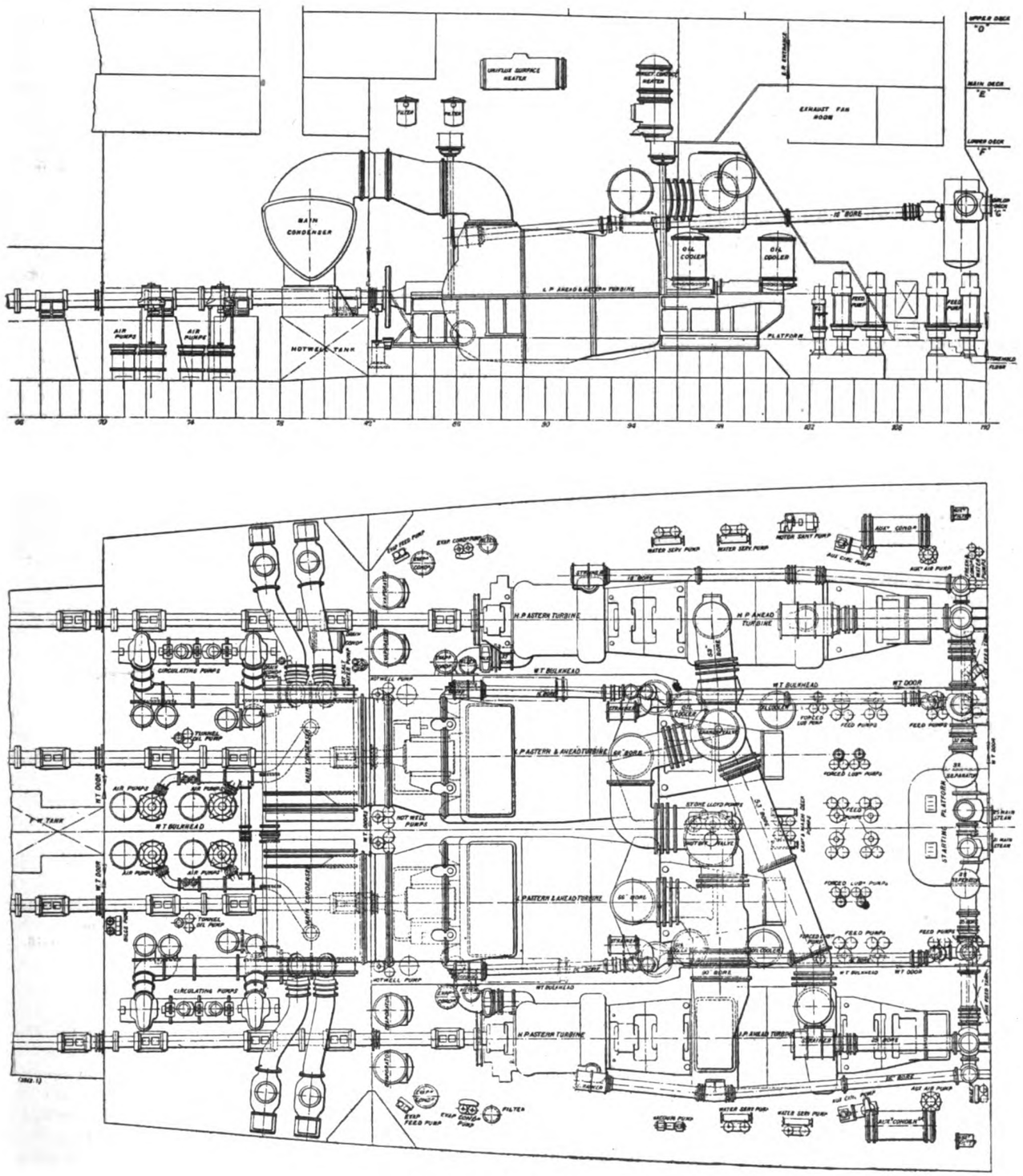

Fig. 9.—Machinery Arrangement (Reproduced from *Engineering*)

The "E" deck is regarded as the "working deck of the ship," although the first class swimming bath and gymnasium are situated on this deck. At the after end of this deck are staterooms for second class passengers and large spaces for third class promenades. There is a passage extending right

several decks in the forecastle, while the stewards are berthed aft.

The ship has twenty-eight pairs of davits, consisting of both the swan-neck type and the Welin type, while among her boats are two motor lifeboats fitted with wireless telegraphy.

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There are in all eighty lifeboats providing ample accommodation for all people on board the ship.

Interior Decorations

The restaurant in the first class accommodation measures nearly 150 feet in length and 97 feet in width; the height at the sides is 10 feet and in the center, where there is a large well 41 feet by 23 feet, the room attains a height of 19 feet; the floor area is 13,500 square feet. The decoration is in the Louis XVI style, and the woodwork is in paneled mahogany and painted grey, the whole being enriched with carved ornament and decorative paintings.

The general scheme of decoration which has been chosen for the first class lounge is that in vogue about the time of George I, and is reminiscent of the work of Sir Christopher Wren. The color scheme is wine red and vellum. The center of the room, which is 18 feet in height, is ornamented with a genuine old ceiling painting on canvas, representing an allegorical subject, and signed by Van Cuygen, a well-known decorative painter of the Dutch school. The room has large Georgian windows overlooking the garden lounge. A semicircular stage or platform is planned at one end of the room, decorated with a fine coffered vault, under which is a reproduction of the famous tapestry representing the battle of Solebay. The floor, which is of oak and suitable for dancing, is covered with a plum-colored trellis carpet, the center being a replica of a fine Savonnerie example.

The general idea in the first class smoking room has been to retain a ship effect, with architectural proportions. The plan of the room generally is interesting. It is 76 feet long and 52 feet wide, with a lofty central portion and fine spacious rooms adjoining, divided off by glaced and paneled partitions, with oak carvings of nautical trophies and draperies.

The long gallery stretches for nearly 150 feet—from the first class smoking room to the lounge. On the port side large sash windows overlook the deck promenade and the sea. The walls are paneled in mahogany and the period of decoration is about 1780, the black and grey tiling of the floor harmonizing admirably.

Stretching for a distance of nearly 150 feet on either side of the public rooms on "A" deck is the garden lounge, the surroundings of which are reminiscent of an Old English garden.

The entrance hall and main staircase, the writing rooms and the foyer or reception room, are all decorated in the Louis XVI style, while the grill room is of the early Jacobean period.

The accommodation provided for second class cabin passengers is remarkably complete, including three features which are usually only available for first class passengers—a verandah café, lounge and gymnasium. The public rooms are very large and the decoration, while less elaborate than in the first cabin, is worked out in a very tasteful manner.

Boilers

Steam is supplied at a pressure of 195 pounds per square inch by twenty-one double-ended, eight-furnace Scotch boilers, each 17 feet 8 inches mean diameter and 22 feet long. The total heating surface of all the boilers is 138,595.8 square feet and the total grate surface, 3,541.8 square feet, making a ratio of heating surface to grate area of 39.1 to 1. The shell plates are 1 19/32-inch thick, the front tube plates 25/32-inch thick and the back tube plate 13/16-inch thick over the center furnaces and 7/8-inch thick over the outer furnaces. The plain tubes are of iron 2½ inches outside diameter of 8-wire gage, while the stay tubes are from 2½-inch diameter and ¼-inch thick to 2½-inch diameter by ⅜-inch thick.

The boilers are arranged in four separate boiler rooms, six boilers are arranged three abreast in each of the three forward boiler rooms, while the after boiler room contains only three boilers. The total boiler space, including cross bunkers and auxiliary machinery rooms is 369 feet long and 60 feet wide, while the remaining space on each side from the longitudinal bulkheads to the shell of the vessel is utilized for coal bunkers. Cross bunkers are arranged between the first and second and second and third boiler rooms, while between the third and fourth boiler rooms, at the H-deck level, is the electric plant and below this an auxiliary machinery compartment.

Seven Stone's ash expellers are fitted in recesses in each boiler room. The capacity of the pumps for each expeller is approximately 4,500 tons per hour, and as these pumps can be utilized in emergency as bilge pumps their capacity adds a valuable margin of safety in case of disaster.

Howden's latest system of forced draft is applied to all the boilers. Twenty-eight electrically-driven fans, located in separate fan rooms on the G-deck level, supply the air for combustion. The fans are 66 inches diameter, designed to run at a speed of 450 revolutions per minute against a pressure of 3½ inches of water. Each pair of fans is driven by one Allen electric motor of 50 horsepower.

Propelling Machinery

Propulsion is by Parsons turbines of approximately 56,000 horsepower arranged according to the triple expansion system on four shafts. Two longitudinal bulkheads divide the engine room into three compartments—the high-pressure ahead and the high-pressure astern turbine are in the port engine room, the intermediate-pressure ahead and another high-pressure astern turbine are in the starboard engine room, while two low-pressure ahead turbines, in which are incorporated the low-pressure astern turbines, are in the center engine room, actuating the two center shafts. Aft of the turbine rooms are the two main condensers, located in separate compartments.

The high-pressure ahead turbine is 40 feet 2 inches long overall and weighs 240 tons. The high-pressure ahead rotor drum is 9 feet 2 inches diameter and weighs about 80 tons. The drum is in two portions connected by a heavy junction wheel. There are four stages of expansion in this turbine, the blades varying from 3⅜ inches to 7 inches long. The casing of the turbine is of cast iron. The high-pressure astern turbine, fitted abaft the high-pressure ahead turbine, is 22 feet 11 inches long and weighs 120 tons. There are four expansion stages, the blades varying from 1½ inches to 3 inches long, while the high-pressure astern rotor drum is 7 feet 10 inches in diameter, weighing 40 tons.

The intermediate-pressure turbine is similar to the high-pressure turbine, except for the dimensions. The ahead turbine is 41 feet 6½ inches long and has four expansion stages with the blades varying from 6¾ inches to 14 inches long; the rotor drum is 10 feet 4 inches diameter. As the astern turbine coupled with the intermediate-pressure ahead turbine is a high-pressure turbine, it is a duplicate of the high-pressure astern turbine on the port wing shaft.

The low-pressure ahead and astern turbines on the inner shafts, which are incorporated in the same casings, are 54 feet 3 inches long with rotor drums 12 and 10 feet in diameter respectively. There are nine expansion stages in the ahead turbines and four in the astern turbines. The blades in the former range from 7 to 20 inches long and in the latter from 5 to 7 inches. The ahead and astern drums are connected by a cast steel ring, while the ahead drum, which is in two sections, has a junction wheel of cast steel similar to that used in the high-pressure and intermediate-pressure turbines. Motor-driven gear is arranged for lifting the casings and rotors of the turbines, lifting motors of 30 brake horsepower operating lifting screws through worm gearing.

As shown in the machinery arrangement plans, the high-pressure turbines in the wing compartments are placed well

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forward, while the low-pressure turbines are placed aft close to the main condensers. At the after end of the wing compartments are located the evaporating plant, auxiliary pumps and the auxiliary condensers. At the forward end of the center turbine room are located the main feed, sanitary and forced lubrication pumps. Forced lubrication is supplied to all the turbine bearings as well as to the tunnel shaft bearings. For the latter, six direct acting Weir pumps, 12½ by 10 by 24 inches are required, four being used to maintain the oil supply.

The two main condensers are of Weir's uniflux type, constructed by Messrs. John Brown & Company, Ltd., each having 23,000 square feet of cooling surface, circulation being on the double-flow system. The main circulating pumps supplied by Messrs W. H. Allen, Son & Company, Ltd., are four in number arranged in two pairs. The steam cylinders are 14 inches in diameter by 10½ inches stroke, each engine being capable of delivering 18,500 gallons of water per minute against a total suction and delivery head of 31 feet 6 inches, the speed being 350 revolutions per minute. Each condenser is supplied with two sets of Weir dual air pumps, the air cylinders being 38 inches diameter by 21 inches stroke, each driven by a steam cylinder 20 inches diameter by 21 inches stroke.

The exhaust from the auxiliaries and the turbo electric plant is led to auxiliary condensers at the forward end of each wing turbine room. The auxiliary condensers are of Weir's unflux type with 2,000 square feet of cooling surface each. The circulating pumps supplied by Messrs. Allen deliver 2,500 gallons of water per minute against a 20-foot head when running at a speed of 330 revolutions. The air pumps of Weir's monotype design have air cylinders 24 inches diameter and steam cylinders 12 inches diameter, both with a 15-inch stroke.

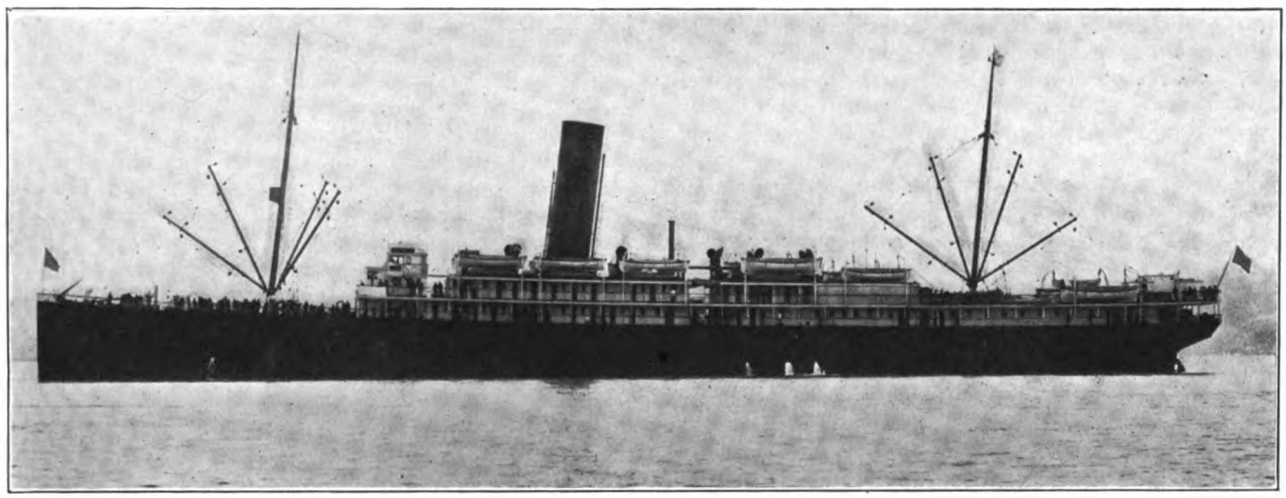
AUXILIARIES

Three pairs of Weir's standard feed pumps, supplemented by a duplicate installation of auxiliary feed pumps, are located at the forward end of the center turbine room. These pumps have water cylinders, 13 inches diameter and steam cylinders 18½ inches diameter by 27 inches stroke. Four Weir hotwell pumps, 14 inches by 12 inches by 26 inches stroke, are located in each condenser room, each pump being capable of delivering the feed water for 14,000 shaft horsepower. Four Harris feed water filters arranged in pairs on each side of the center turbine room are supplied and two Weir uniflux surface feed heaters, each with a heating surface of 1,000 square feet, capable of dealing with the feed water for 28,000 shaft horsepower. Other pumps in the central turbine room include a vertical duplex 11-inch by 10-inch by 10-inch sanitary pump, and a similar one for deck and fire purposes with a capacity of 200 tons per hour and three pumps for the Stone-Lloyd watertight door system.

Ventilation of the machinery compartments is accomplished by the plenum system, the fan equipment for which consists of nineteen motor-driven Keith-Blackman supply and exhaust fans with an aggregate capacity of 660,000 cubic feet of air per minute. The refrigerating plant, installed for the preservation of the ship's stores, is of the carbonic-anhydride type, manufactured by the Liverpool Refrigeration Company, Ltd., Liverpool. For ventilating the passenger quarters the thermo-tank system has been adopted, the installation consisting of about 100 units electrically operated.

THE ELECTRIC PLANT

Electricity is supplied by four 400 kilowatt 1,500 revolutions per minute 225-volt direct-current turbo generating sets of the British Westinghouse type, located on the G-deck, between the second and third boiler rooms, while an emergency set, consisting of a 45-brake horsepower Diesel engine, supplied by Messrs. Mirrlees, Bickerton & Day, coupled to a Westinghouse 30-kilowatt generator, is located on the promenade deck for emergency purposes. Current is supplied for about 180 motors aggregating over 2,000 horsepower, and for about 10,000 lamps.



Steamship *President* Converted into an Oil Burner by the Seattle Construction and Dry Dock Company

Steamships President and Governor Changed to Oil Burners

In view of the fact that the Pacific Coast Company, holding corporation of the Pacific Coast Steamship Company, owns and operates extensive coal mines adjacent to Seattle, the conversion of the steamships *President* and *Governor,* owned by the Pacific Coast Steamship Company, from coal to oil burners, is of peculiar significance. The alterations in these vessels were made at the plant of the Seattle Construction & Dry Dock Company, Seattle, Wash.

The steamship *Congress,* of the same fleet, built last year at the yards of the New York Shipbuilding Company, Camden, N. J., is also an oil burner. These three vessels are the speediest passenger liners of the North Pacific coast, traveling on express schedule between Seattle and San Diego, via San Francisco and San Pedro. They make a round trip every fortnight, spending three days in Seattle and two days in San Francisco each voyage. Consequently the question of discarding coal in favor of oil was a serious question, and as

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the company operates its own coal mines, it was natural that the Pacific Coast should be one of the last large companies on this coast to adopt oil. More than 90 percent of the coasting steamers in North Pacific waters are now users of oil.

When the *Congress* was planned she was to be fitted as a coal burner, but during construction the plans were changed and the latest addition to the fleet was fitted with oil-burning equipment. Her fuel capacity is 7,500 barrels, giving her a steaming radius of 4,200 miles. On her maiden voyage to the Pacific via the Strait of Magellan she used oil with success, not once during the long run was it necessary to stop the engines on account of fuel troubles. The *Congress* called en route at Trinidad and Taltal to replenish her fuel supply and she arrived at San Francisco in 57 days, including stops.

The *President*, which has just returned to service, was converted at the Seattle yards on a contract working time of thirty-five days. The Dahl high-pressure mechanical system was installed, the contract including the installation of all necessary pumps, heaters, strainers, meters, gages, etc. Her capacity is 5,600 barrels, and on her maiden run following the change the fast steamer added one knot to her steaming speed. As she previously held the steaming record between San Francisco and Seattle of 47 hours and 30 minutes, she is now practically the fastest vessel engaged in coastwise traffic in North Pacific waters.

In making the oil installation, the vessel's double bottom was converted into fuel tanks to carry her capacity, while in the space formerly occupied by the forward coal bunkers was installed the big settling tank to which the oil is pumped from the double bottom tanks. The plans for the *Governor* call for practically the same work, the capacity of the latter to be 5,600 barrels also. This fuel gives each vessel a steaming radius of practically 3,150 miles. As the distance of each voyage to San Diego and return is approximately 2,623 miles, each vessel has ample surplus. On each call at San Pedro the vessels will fill their oil tanks.

Using coal, these vessels formerly filled their bunkers with about 1,350 tons upon each call at Seattle. This operation required nine working hours, which frequently meant from twelve to fifteen hours, including waste time. Now the vessels can fill their tanks while working cargo, thereby effecting a considerable saving in time, which is no insignificant item when it is recalled that these vessels are almost constantly moving and are running on a schedule almost as exacting as that of an express train.

Roughly estimating the value of coal at $3.30 (13/9) per ton and that of fuel oil at 80 cents (¾) per barrel, it is figured that the *Governor* and *President* will effect a saving in fuel cost alone of between $800 (£164) and $1,000 (£205) per voyage. While the cost of installation is heavy, probably between $30,000 (£6,150) and $40,000 (£8,200), the economy of oil over coal will soon repay the outlay.

There are, however, other important features of oil burning which appeal to the owners. With the elimination of coal bunkers, each vessel has approximately 600 tons of additional cargo space, which is of much value considering the demand for such space, especially at certain seasons. Probably the most important economy effected, however, is that in crew. Formerly the *President* carried a total of 136 men, and now her roster is but 113. The reduction of twenty-three men is apportioned to twenty-one in the engine department and two in the steward's department, the latter being eliminated following the reduction of the fireroom force. Whereas, the engine room crew formerly numbered forty-four, there are now but twenty-three required. In addition to the saving in wages and subsistance of these men, the quarters formerly occupied by them have been turned into added cargo space. Only those who know the difficulty of obtaining competent and trustworthy seagoing men on this coast can appreciate the economy effected by this reduction in crew.

When using coal on these vessels, it was customary to clean fires with the change of watches every four hours. This resulted in a loss of steam, requiring more coal and increased revolutions to make up the difference. With oil a steady fire and steady steam pressure are maintained, enabling the express liners to make better time and resulting in lesser strain on machinery and engines.

The loss of the coal business to the steamships is not felt by the mines, for this output finds a ready demand everywhere, so that, considering the fine record already made by the *Congress* and *President*, the company is more than pleased with the change.

The *President* and *Governor*, like the *Congress*, were built at Camden by the New York Shipbuilding Company, the *President* in 1906 and the *Governor* a year later. They have been operating steadily on the Seattle-San Diego route and have done much in building up a constantly growing passenger traffic between California and Puget Sound. In addition to carrying general cargo, the speed of the fine liners makes them popular in carrying perishable goods. They have proved an immense success on this route, and, with their increased speed and greater earning capacity with oil, it is expected that they will prove more popular with the traveling public and more satisfactory to their owners.

Among other vessels recently installed with oil burners by the Seattle Construction & Dry Dock Company are the following: the steamships *Tacoma, Potlatch, Kulshan, Sol Duc, Sioux, Comanche, Latouche, Stanley Dollar, Falcon, Princess Adelaide;* the tugs *Pioneer, Milwaukee;* the United States suction dredge *Colonel P. S. Michie*, and the yacht *Cyprus*.

LAUNCH OF THE ATLANTIC.—The steamship *Atlantic*, one of two sister ships now under construction at the yards of the Fore River Shipbuilding Corporation, Quincy, Mass., for the Emory Steamship Company, of Boston, was launched May 26. The *Atlantic* is a single-screw vessel of the single-deck type, 405 feet 9 inches long over all, 388 feet long between perpendiculars, with a molded beam of 54 feet 4 inches and a molded depth of 31 feet 8 inches. The cargo space is subdivided by transverse watertight bulkheads into three cargo holds of exceptionally large size, adapted for carrying lumber or bulk cargo, such as coal, grain, etc. Arrangements are also made for carrying a large deck cargo of lumber. Propulsion is by a triple-expansion engine, with cylinders 25, 41 and 68 inches diameter and 48 inches stroke, supplied with steam at 190 pounds pressure from three single-ended coal-burning Scotch boilers, 13 feet 9 inches diameter and 11 feet 10 inches long, working under heated forced draft on the closed ash-pit system. The auxiliaries include a 25-ton evaporator, a 1-ton refrigerating machine, a 15-kilowatt General Electric marine generating set and nine Lidgerwood cargo-handling winches. The vessel has a straight stem, a semi-elliptical stern and a single steel upper deck with a full poop, a bridge house amidships and a top gallant forecastle.

NEW DESTROYERS FOR THE TURKISH NAVY.—The Chantiers et Ateliers Augustin Normand, of Havre, France, has received an order from the Turkish Government for twelve torpedo boat destroyers, of which six are to be built at once, and the other six within three years. The destroyers are 287 feet long between perpendiculars with a displacement of 1,040 tons. Propulsion is by Parsons turbines of 22,000 horsepower, supplied with steam from four Normand boilers having a total heating surface of 25,824 square feet. According to specifications, the vessels must average a speed of 32 knots on a six-hour trial. The armament consists of five 4-inch guns and six 21-inch torpedo tubes.

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The Submarine Tender Fulton

Description of the First Submarine Tender Built for the United States Navy—Diesel Engines Installed

There is now nearing completion at the works of the Fore River Shipbuilding Corporation at Quincy, Massachusetts, the first submarine tender for the United States Navy. This vessel, named the *Fulton*, is from the designs of the New London Ship and Engine Company, of Groton, Connecticut, by whom her engines were also designed and built. She is of interest, not only as being the first of a new type of vessel, but also as being the first large vessel for the Navy equipped with Diesel engines.

The *Fulton* was launched June 6 and christened by Mrs. Alice Crary Sutcliffe, the great-grand-daughter of Robert Fulton, for whom the vessel is named. Unlike most naval ships, the *Fulton* was built to merchant specifications, and when in service will be the mother ship for a division of submarines.

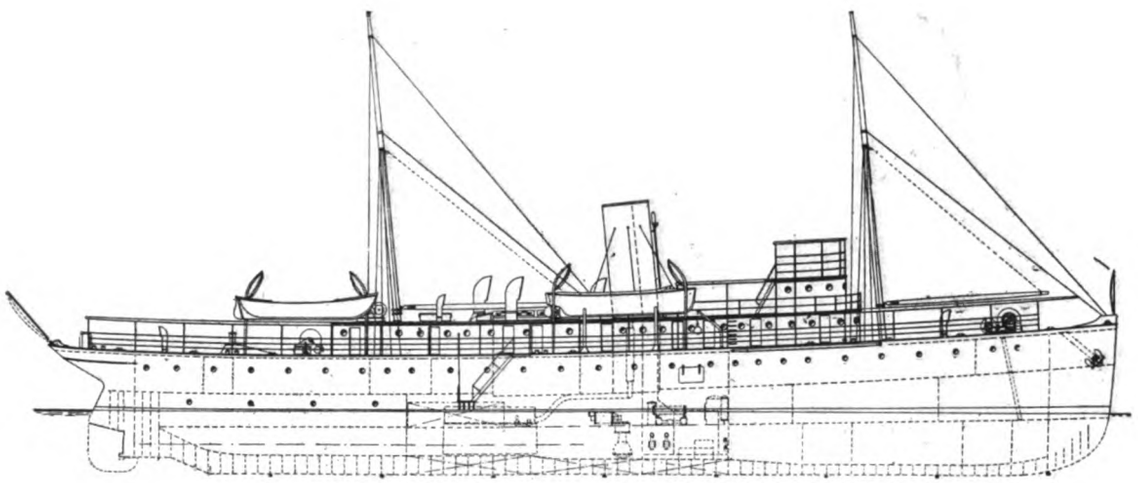

Fig. 1.—Outboard Profile of the Diesel-Engined Submarine Tender *Fulton*

The principal dimensions of the vessel are as follows:

Length over all	226 feet 6 inches
Beam	35 feet
Draft, load	12 feet 11½ inches

The crew consists of about 190 officers and men.

The object of the design has been to furnish a vessel for an auxiliary to submarines, which may accompany them and carry necessary fuel, stores and ammunition, and which may, at the same time, be able to perform routine repairs to their machinery and outfit, and to charge their air flasks, storage batteries and fuel tanks. For this reason the military features of the design have received minor attention, and all possible weight and space have been devoted to storerooms, oil tanks, and machine shops. As it is necessary for the tender to carry fuel oil for the submarines, it is desirable that she also use the same fuel for propulsion, in order to obviate the necessity of storing two kinds of fuel—oil and coal. This object might, of course, have been attained by using either a steam plant with oil-burning boilers or oil engines. The latter were chosen on account of their much greater fuel economy, which gives greatly increased carrying power with the same radius of action. The space required for propelling machinery is also materially reduced.

General Arrangement

The vessel is of the flush-deck type, with two principal decks —the upper deck and berth deck, and with partial platform decks at the ends. Upon the deck is a deck house. There are two pole masts with derrick booms.

The hold contains the chain locker, storerooms, warhead and ammunition magazines and fuel tanks. The main engines and auxiliary boiler room are located amidships. On the platform deck are storerooms and torpedo magazines forward, and crew's space aft. On the berth deck are crew's quarters and petty officers' quarters aft, machine shop amidships, and torpedo testing room and wardroom quarters forward. In the deck house are located the commander's cabin, offices, galleys, and sick bay. A pilot house is located over the forward end of the deck house.

It will be seen that the distinguishing feature of the hull arrangement is the provision of ample stowage space, magazines, crew space, a machine shop, and a torpedo testing room. The storerooms are divided into two groups, those for the tender's stores, and those for submarine spares and stores. The fuel oil, carried in the double bottom space and in a transverse tank in the hold, is sufficient for the vessel's own use, and for supplying a division of submarines. The crew's quarters furnish accommodations for submarine crews as well as for the necessary crew for the tender.

The torpedo testing room, located on the berth deck, is so placed that torpedoes can be passed from it directly to the torpedo magazine. The warhead magazine in turn is immediately under the torpedo magazine, so that the warheads may be hoisted directly from it to the latter. The machine shop lies immediately abaft and to the port side of the torpedo testing room, about the engine hatch. This grouping of the torpedo rooms and machine shop together facilitates tests and repairs. The machine shop is equipped with lathes, shapers, drill presses, milling machines, and the other necessary machine tools for repairs to the engines and auxiliaries of the submarines.

The sick bay is of large size, with separate bath, dispensary and laboratory, in order that it may care for sick or injured from both the submarines and the tender. It is located in the deck house, in a light and airy position.

As the main engines are of the internal combustion type, it was desirable to stall an auxiliary boiler for supplying steam to the heating system, and for driving such auxiliaries as the anchor windlass, the steering engine, towing machine, and the evaporator plant, which cannot well be driven by electricity. The boiler room is located in the hold, forward of the engine room, and besides the boiler, contains feed pumps, distiller circulating pumps, sanitary pumps, air pumps, all of which

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are steam-driven, condenser, feed water heater, evaporator and distiller. The boiler is equipped to burn fuel oil. This steam plant, being merely an auxiliary, is of comparatively small capacity, and creates only a comparatively small drain on the fuel supply, especially as it need be run at full power only under exceptional cases.

PROPELLING MACHINERY

On account of its novelty probably the most interesting feature of the vessel is the main propelling machinery. This consists of a single vertical, inverted, two-cycle, single-acting air-starting and reversing oil engine of the Diesel type, with six working cylinders and two air compressors. The shaft horsepower delivered is about 1,000 at about 260 revolutions.

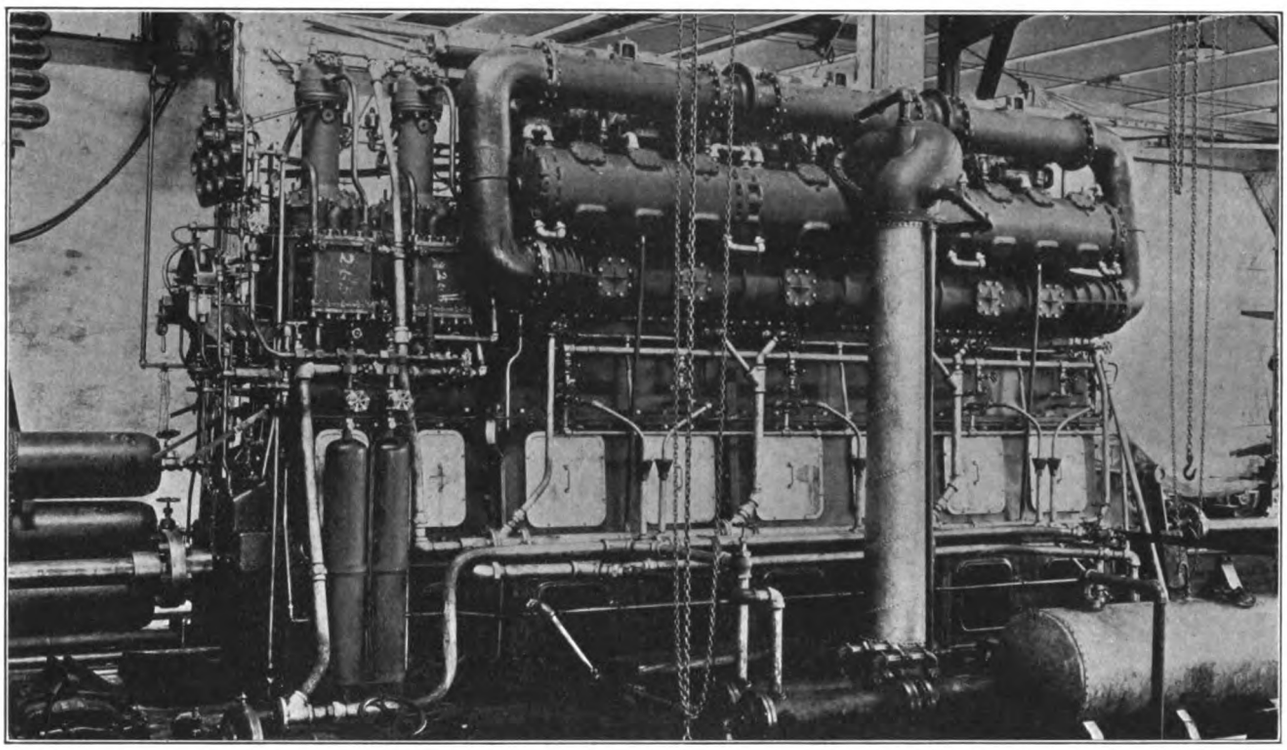

Fig. 2.—The *Fulton's* 1,000-Horsepower Diesel Engine on the Test Stand

Fig. 2, which shows the engine on the test stand, gives a general idea of the arrangement. The six working cylinders and two air compressors are on the same fore and aft line, the air compressors being at the forward end of the engine, where is located the control station. The engine is entirely controlled, starting, stopping, changing speed, and reversing, through a hand wheel at this station. The pistons are of the stepped type, the upper part forming the working piston, and the lower the scavenging piston. From the scavenging cylinder the scavenging air at low pressure is carried to an external receiver, whence it goes to the working cylinders, and overboard through the exhaust. This arrangement of scavenging cylinders has the advantage that any leakage of gases from the working cylinder, due to leaky piston rings, passes into the scavenging air, with no possibility of escaping into the engine room. In addition the crank pit is entirely enclosed. In larger engines now under construction it has been found desirable to use an open crank case form of construction, but for engines of this speed with forced lubrication, the closed crankcase has advantages, and as large, quickly-removable crankcase covers are provided, which may be removed while the engine is in motion, it is free from the disadvantage of inaccessibility.

Each working cylinder is provided with two scavenger valves, an air-starting valve, a spray valve and a relief valve. The spray valve atomizes and injects the fuel into the cylinder by means of high pressure air from the air compressors.

The scavenger valve is connected to the scavenger air receiver. All valves are driven from a cam shaft carried in bearings on top of the cylinder heads. This cam shaft is driven from the crankshaft through a vertical shaft and spiral gears. A special feature is a pneumatic cylinder which, when reversing, automatically places the cam shaft in the proper position relative to crankshaft, before air is admitted to the cylinders for starting the engine.

The wrist pins are of large size, giving very moderate bearing pressures, and located in the scavenger piston, where the temperatures are low. The scavenger cylinder acts as a crosshead guide, and is watercooled. A novel feature is the use of fresh water for cooling the pistons. Water is carried to the pistons through pipes with swinging joints, so that a continuous circulation of fresh, cool water is insured. The lubrication is of the pressure type, lubricating oil being supplied by a small lubricating oil pump. The cylinders and cylinder heads are water-cooled by a salt water system independent of the fresh water system above mentioned.

AIR COMPRESSORS

The air compressors are two-stage, and supply air for spraying the fuel and for charging the starting flasks. The cylinders and heads are water-jacketed, and the air is passed through cooling coils after the first and second stages. The air flasks are also connected to the independent ship's high pressure air line, so that air may be drawn from the latter in emergency.

The pumps form two independent motor-driven units. Each unit consists of a centrifugal salt water pump, a rotary fresh water pump, a rotary lubricating oil pump, and a rotary fuel oil pump. One unit is sufficient for the engine at full power; the other being a stand-by. The rotary fuel pump takes suction from the oil storage tanks, and discharges to a gravity feed tank in the engine hatch, whence the fuel flows to the

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measuring pumps on the engine. These pumps discharge the oil in the proper measured qnantities for the power desired. A direct driven governor positively controls the quantity of oil discharged by the measuring pumps, and hence the power delivered.

The electric plant is of considerable size, as the tender is designed to be capable of charging the batteries of submarines, in addition to supplying its own electrical needs. There are two generators, driven from the forward end of the main engine crankshaft. A small turbo-driven generator is installed for lighting the ship. There are also two motor-driven air compressors of sufficient capacity to charge torpedoes or the air flasks of the submarines. A small low-pressure air compressor is installed for supplying air to pneumatic tools.

Taken all in all, it appears that this vessel promises to be a very useful accessory to our submarine flotilla. It will be a step towards the elimination of the makeshift mother ships for submarines, the use of which has been rendered necessary by the lack of vessels especially designed for such service.

The Empress of Ireland Disaster

Through collision with the collier *Storstad,* a few miles above Father Point in the St. Lawrence River early in the morning of May 28, the Canadian Pacific liner *Empress of Ireland* was sunk with the loss of nearly 1,000 lives. The ill-fated ship was rammed by the *Storstad* nearly amidships and immediately took a heavy list. Within less than a quarter of an hour the ship had sunk.

Conflicting testimony by the captains of the two vessels at present leaves the exact circumstances regarding the disaster in doubt. The two vessels had sighted each other when about two miles apart, but were afterwards enveloped in fog. Capt. Kendall, of the *Empress of Ireland,* says that the engines of his vessel were going astern, and that the vessel was without headway at the time of the collision, while Capt. Anderson, of the *Storstad,* claims that the *Empress of Island* was moving ahead rapidly, and that it was impossible for him to keep the bow of his vessel against the ship to "plug" the hole made by the impact. Fortunately the wreck of the *Empress of Ireland* lies in comparatively shallow water, so that investigation by divers is possible in order to determine the extent and nature of the damage to the hull. The extent of the damage to the bow of the *Storstad* is shown in Fig. 2.

The *Empress of Ireland* was built by the Fairfield Shipbuilding & Engineering Company, Ltd., Glasgow, in 1906. Her dimensions were: Length over all, 570 feet; beam, molded, 65 feet 6 inches; depth to upper deck, 40 feet; displacement, 20,000 tons, and load draft, 28 feet. Her propelling machinery consisted of two sets of quadruple expansion engines, each of which, running at 80 revolutions per minute, indicated over 9,000 horsepower. Steam was supplied at a pressure of 220 pounds per square inch by six double and three single-ended

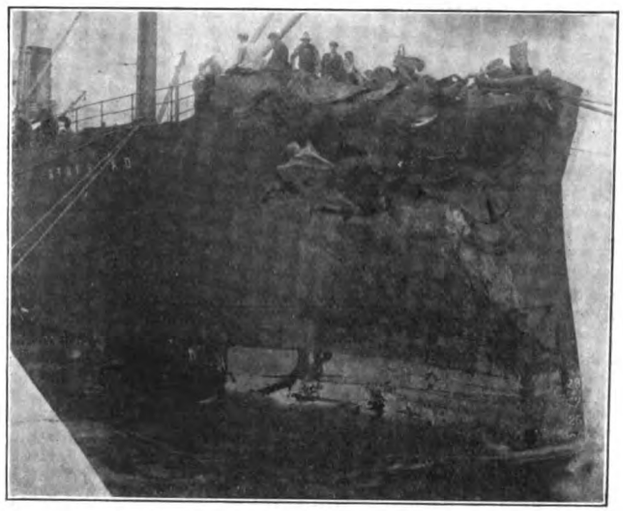

Fig. 2.—Damaged Bow of the *Storstad*

Scotch boilers, placed in two boiler rooms with a large coal bunker between them. The subdivision of the hull was by nine watertight bulkheads extending to the level of the upper deck, together with a cellular double bottom.

The dangers of navigation in fog have been further emphasized during the last few weeks by several other collisions involving large passenger vessels, although none has resulted in the loss of life. On the morning of May 22 the Lake freighter *W. H. Gilbert,* loaded with, coal, bound from Toledo to Green Bay, Wis., collided with the steamer *Caldera* in fog a few miles from Thunder Bay Island, Lake Huron. The *Caldera* rammed the *W. H. Gilbert* amidships, nearly cutting her in two, so that within five minutes she had sunk. On the Atlantic the Hamburg-American liner *Pretoria* collided with the American Liner *New York* on June 13 off the coast of Massachusetts, tearing a large hole in the port bow of the *New York* above the waterline, but sustaining only slight damage herself. Four days later the German grain carrier *Incemore* collided with the North German Lloyd steamship *Kaiser Wilhelm II,* which had left Southampton a few hours before bound for New York. The *Kaiser Wilhelm II* was struck on the starboard bow and sustained damage below the waterline, while the bow of the *Incemore* was badly crumpled.

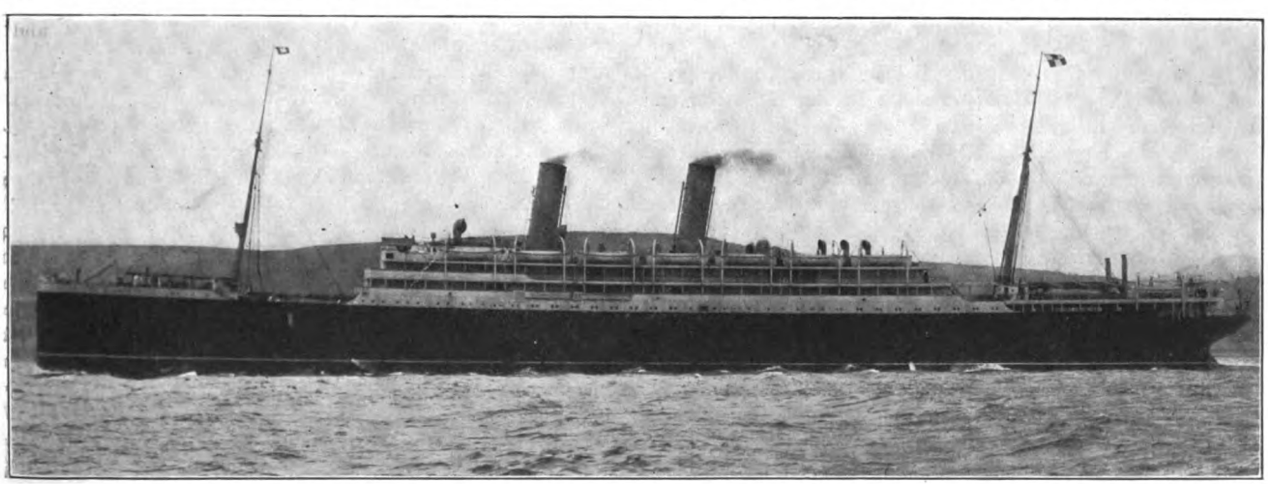

Fig. 1.—The *Empress of Ireland,* lost through collision with the *Storstad* on the St. Lawrence River, May 28

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New Steamship Piers at Boston

In an article on "The Development of the Port of Boston" by Robert E. Barrett, designing engineer, Directors of the Port of Boston, in a recent issue of *Engineering News*, a comprehensive outline is given of the work already done and now in prospect for the development of steamship piers and other shipping facilities in Boston.

In 1911 the Commonwealth of Massachusetts created an independent board, known as the Directors of the Port of Boston, and made an initial appropriation of $9,000,000 (£1,840,000) for meeting the future needs of maritime commerce at this port. The expenditure of practically all of this sum has now been authorized for the construction and equipment of piers and for the construction of a drydock 1,200 feet long overall and 120 feet wide at the bottom, with a depth of 35 feet of water over the entrance sill at mean low water.

The work of pier construction is being carried out on property acquired by the Commonwealth in South Boston and East Boston. In South Boston, where five piers owned or leased by the New York, New Haven & Hartford railroad have been in use for some time, attention was directed by the Directors to Pier No. 5, which is 1,200 feet long and 400 feet wide, with the docks dredged to a depth of 35 feet of water at mean low water. By an agreement with the New York, New Haven & Hartford railroad possession of this pier was obtained by the Directors and $3,000,000 (£615,000) were allotted to its development, the proposed improvements to include dredging the berths and approaches to a depth of 40 feet at mean low water; covering the entire pier with two-story fireproof sheds supplied with best of facilities for handling both freight and passengers; laying railroad tracks on the pier; providing necessary highway connections, including a steel viaduct for passenger traffic from the second story of the pier to Summer street, by which the city proper is reached by a street clear of railroad grade crossing—a distance of 1200 feet.

The pier structure (Fig. 3) consists of three sheds connected together with light wells 20 feet wide between them. All floors are to be used for freight except the second floor of the middle shed, which is to be fitted for the accommodation of passengers. For 100 feet at the shore end a headhouse, architecturally treated with artificial stone, is being erected. This headhouse will contain offices, passenger accommodations and a carriage concourse on the second floor connecting with the viaduct to Summer street.

The pier has been designed for the use of one steamship company on each side of the pier, the passenger accommodations covering an area of about 130,000 square feet, being located on the second floor of the middle shed.

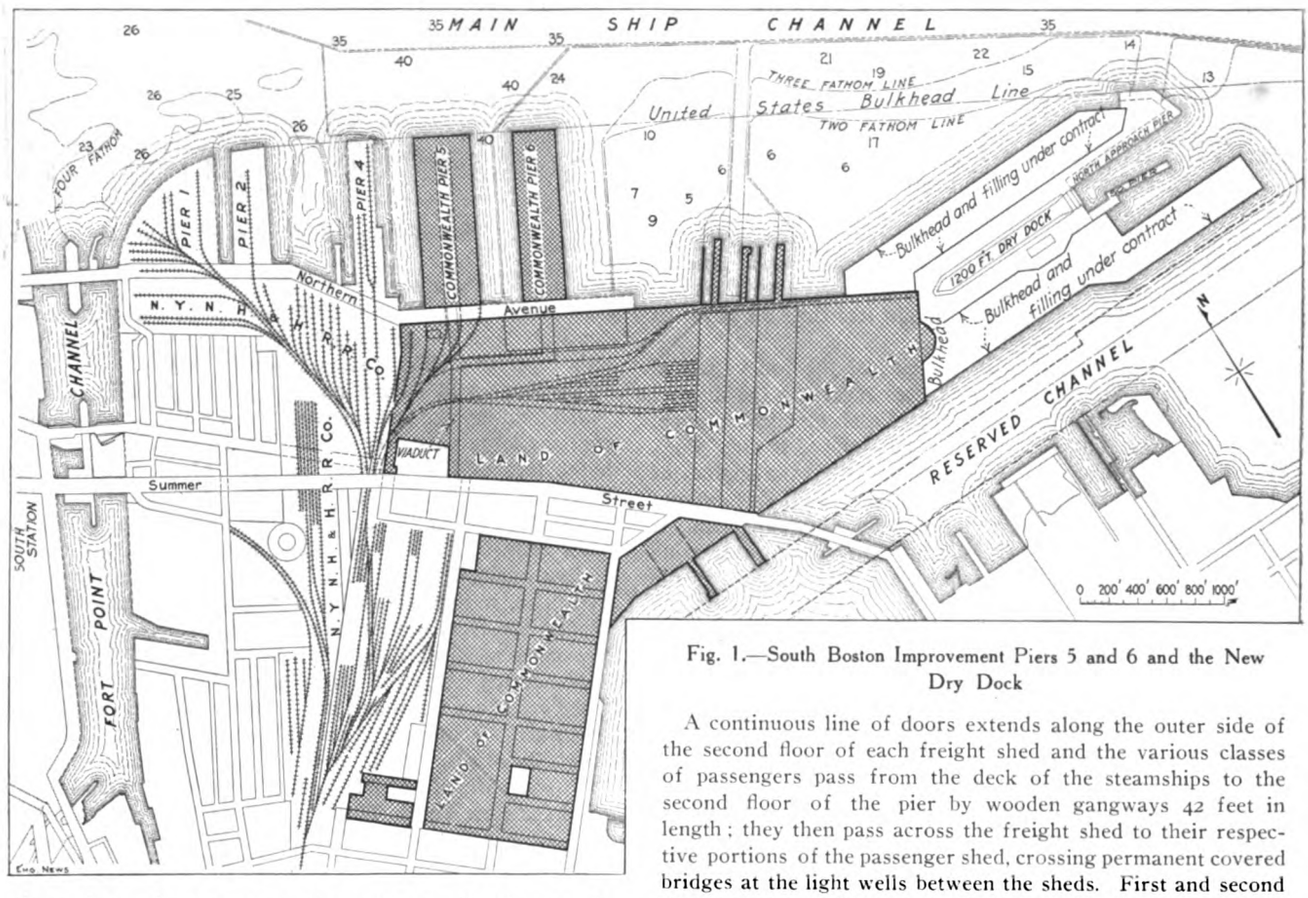

Fig. 1.—South Boston Improvement Piers 5 and 6 and the New Dry Dock

A continuous line of doors extends along the outer side of the second floor of each freight shed and the various classes of passengers pass from the deck of the steamships to the second floor of the pier by wooden gangways 42 feet in length; they then pass across the freight shed to their respective portions of the passenger shed, crossing permanent covered bridges at the light wells between the sheds. First and second class accommodations are located at the land end of the pier and emigrant accommodations are located at the harbor end of the pier, considerable space being occupied by the examination lines, detention room, hearing rooms, doctor's room and room for the use of the charitable societies. Baggage rooms and offices are located at the end of the pier adjacent to the headhouse. Steamship and railway ticket offices and an office for U. S. Customs officials are centrally located.

Between the examination rooms and the street are waiting and baggage rooms and the carriage concourse connecting with the viaduct to the city. At the sides of the concourse are the offices of the railway and steamship companies and the directors. The steel viaduct, 1,200 feet long, extends from the pier to Summer street, spans the railway tracks entering the pier on the first floor and the State storage yard for cars, and connects the pier with Boston proper by means of Summer street, and also entirely separates passenger and freight traffic.

Immigrants reach trains on the first floor by means of the

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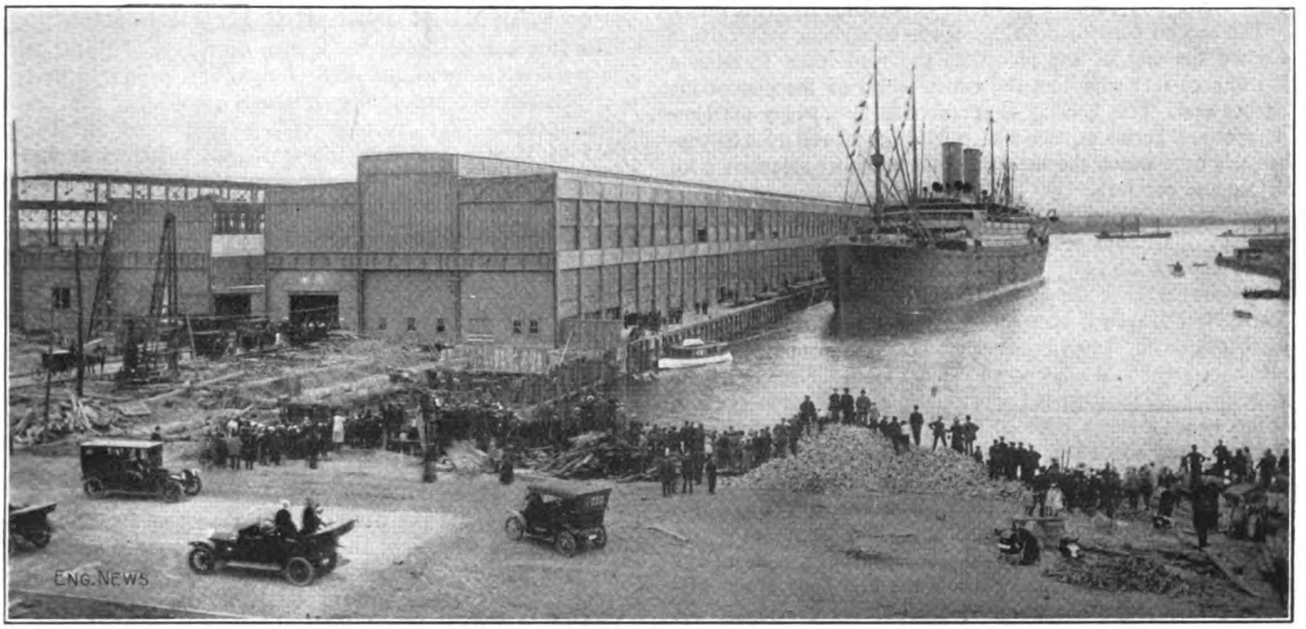
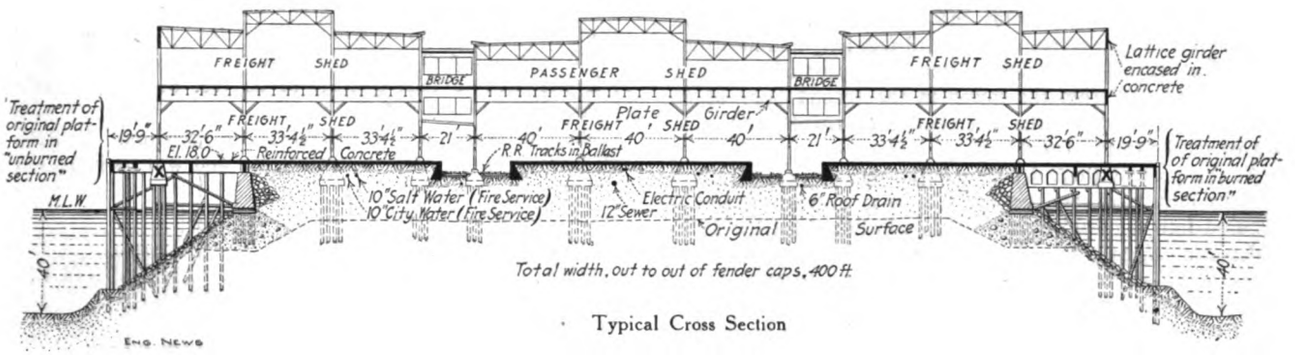
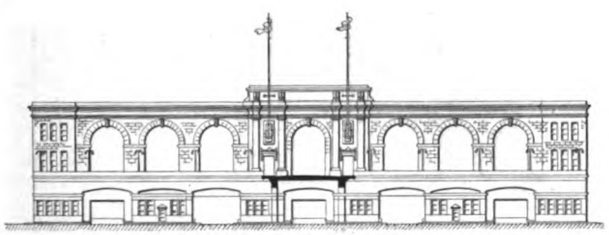


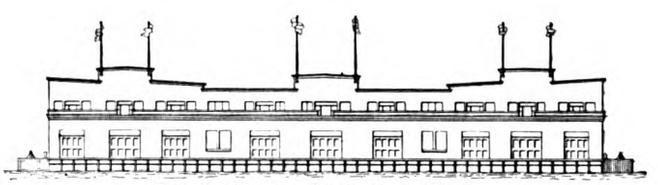
Fig. 2.—Docking of Hamburg-American Liner at Partially Completed Pier No. 5



Typical Cross Section



Front Elevation of Head House



Elevation of Harbor End

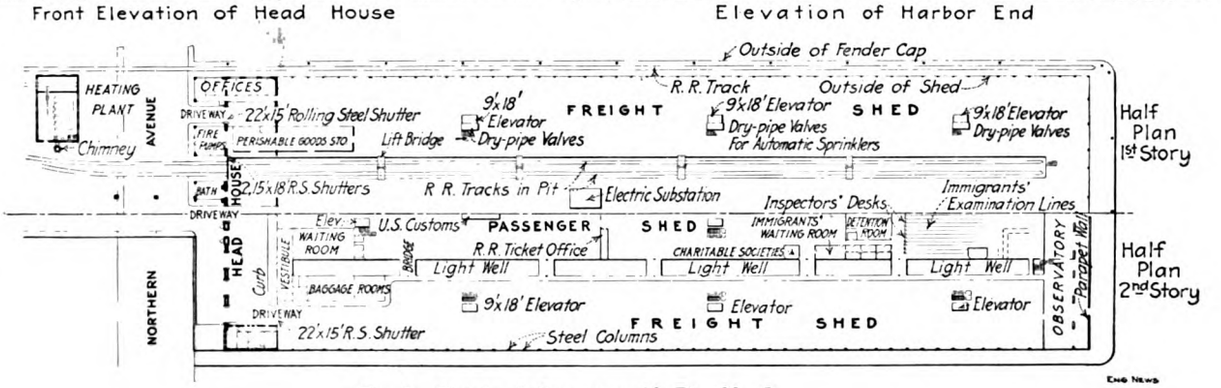


Fig. 3.—Details of Commonwealth Pier No. 5

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steel stairs and suitable elevators connecting the two floors.

The second floor of the three sheds extends 20 feet farther toward the end of the pier than the roof, thus forming a balcony 20 feet wide and the entire width of the pier at the harbor end. This balcony is surrounded by a heavy masonry parapet and forms a place where friends and relatives of passengers may watch the incoming and outgoing steamers with safety and comfort.

The pier is provided with railway tracks sunk below the level of the floors so as to allow direct trucking into the cars. There is also a track on each platform outside the sheds. These tracks have direct connection with lines of the New York, New Haven & Hartford Railroad and the freight yard of that company located just southwest of the pier. By this means, freight and passengers can be landed directly at the vessel, a condition that is impossible in New York at present.

The entire lower portion of the pier and the second floor of the two outer sheds are to be used for freight, the total area devoted to freight being 500,000 square feet. Freight may reach the pier by trucks from Northern avenue or by any of the six standard railway tracks which cross the avenue at grade. A track pit is provided for two tracks on either side of the middle shed, the tracks being below the first-floor grade sufficiently to bring the car and pier floors at practically the same level. A track on reinforced-concrete rail beams is provided on the platforms at either edge of the pier, these tracks being at the level of the floor of the pier.

In addition to the train entrances, there is a driveway entrance from Northern avenue to the center of each of the three sheds for use of teams and auto trucks. Eight elevators with platforms 9 feet wide and 18 feet long and headroom of 10 feet, capable of lifting 12 tons at a speed of at least 25 feet per minute from the lower to the second floor of the pier, are provided for the interchange of freight and hoisting of trucks in the freight sheds.

At the present time, freight on the pier is generally handled by means of hand trucks. Cargo is drawn aboard and lowered into the hold by the ship's winches aided by timber slides and stages. Twenty-six portable electric winches are being provided for use in handling freight. Electric outlets have been placed at frequent intervals along the outer sides of the freight sheds in order that the winches may be used at any point.

For moving of freight across the track pits, lifting bridges have been provided. These bridges are supported on a concrete pier between tracks and two leaves are so designed as to hoist into a vertical position between tracks to allow the trains to pass.

Commonwealth Pier No. 6, 1,200 feet long and 300 feet wide, which is on Commonwealth property adjacent to Pier No. 5, has been deeded to the Boston Fish Market Corporation, which is erecting upon it suitable buildings for stores and warehouses for the various firms in the fish business. This pier provides adequate dock berths for the fleet of fishing vessels trading with the port of Boston.

In 1913 the directors of the port acquired property owned by the Boston & Maine Railroad, located in East Boston and known as "Eastern Pier," in order that a modern pier, to be known as Commonwealth Pier No. 1, equipped for the handling of passenger and freight business, could be constructed in its place.

Plans and specifications are being prepared for the erection of a pier of fireproof construction, about 1,000 feet in length and 175 feet in width, the superstructure to be two stories and of steel, with reinforced-concrete floors.

The first floor will be devoted to the handling of freight, access being obtained by means of two driveways at the level of the floor and by two depressed railway tracks in a track pit along the center of the pier; these tracks to connect with the existing railway system in East Boston.

Honolulu Floating Dry Dock

The Inter-Island Steam Navigation Company, of Honolulu, is a steamship corporation doing freight and passenger business between the five principal islands comprising the Hawaiian group. This group of islands constitutes the Territory of Hawaii, and is by no means an unimportant part of the United States, as its situation, almost in the center of the vast Pacific Ocean, makes it a touching point for nearly every vessel, freight and passenger, crossing the Pacific, and some idea of the size and importance of the inter-island transportation may be gathered from the fact that the Inter-Island Steam Navigation Company has a fleet of eighteen steamers engaged in handling passengers and freight between the islands.

At the time of taking over the islands by the United States Government, there was in Honolulu Harbor a Crandal marine railway designed for a capacity of 1,500 tons. For a number of years this railway answered the purpose of the Navigation Company for handling their vessels, but the continual growth of the business and the necessarily increased size of vessels made a change necessary, and it was finally decided to build a pontoon floating dry dock of ample capacity to handle the largest vessels of their present fleet, with the possibility of extension to a capacity sufficient to handle most of the vessels touching at the islands. The design of this dock was placed in the hands of Mr. William T. Donnelly, consulting engineer and naval architect, New York City.

As shown in the accompanying plan, Fig. 4, the dock as at present constructed has eight pontoons, making a length over all of 352 feet, length of wings of 300 feet, a width over all of 100 feet, and a clear width between the wings of 80 feet. It is designed to take a draft of 20 feet over 4-foot keel blocks.

When increased to a lifting power of 7,000 tons, the dock will have an overall length of 445 feet, and will be increased

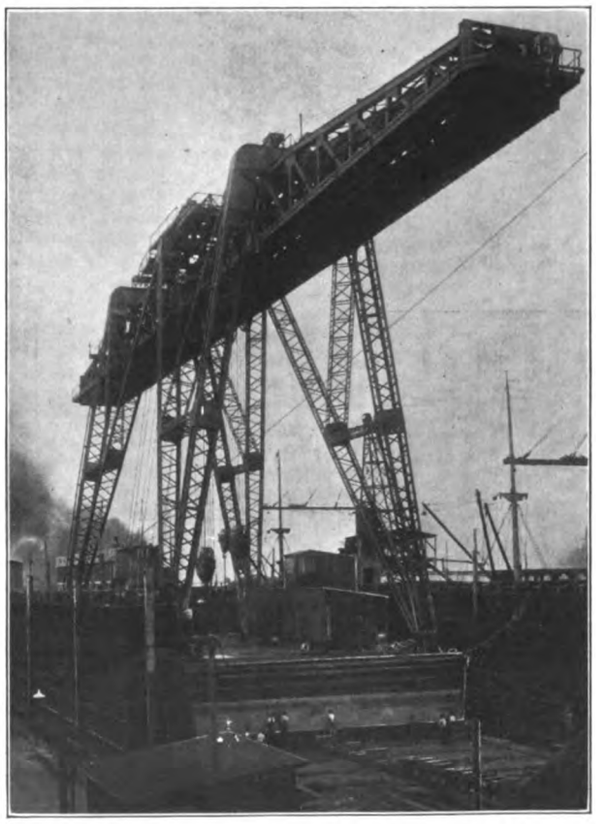

Fig. 1.—Position of Floating Derrick in Dry Dock

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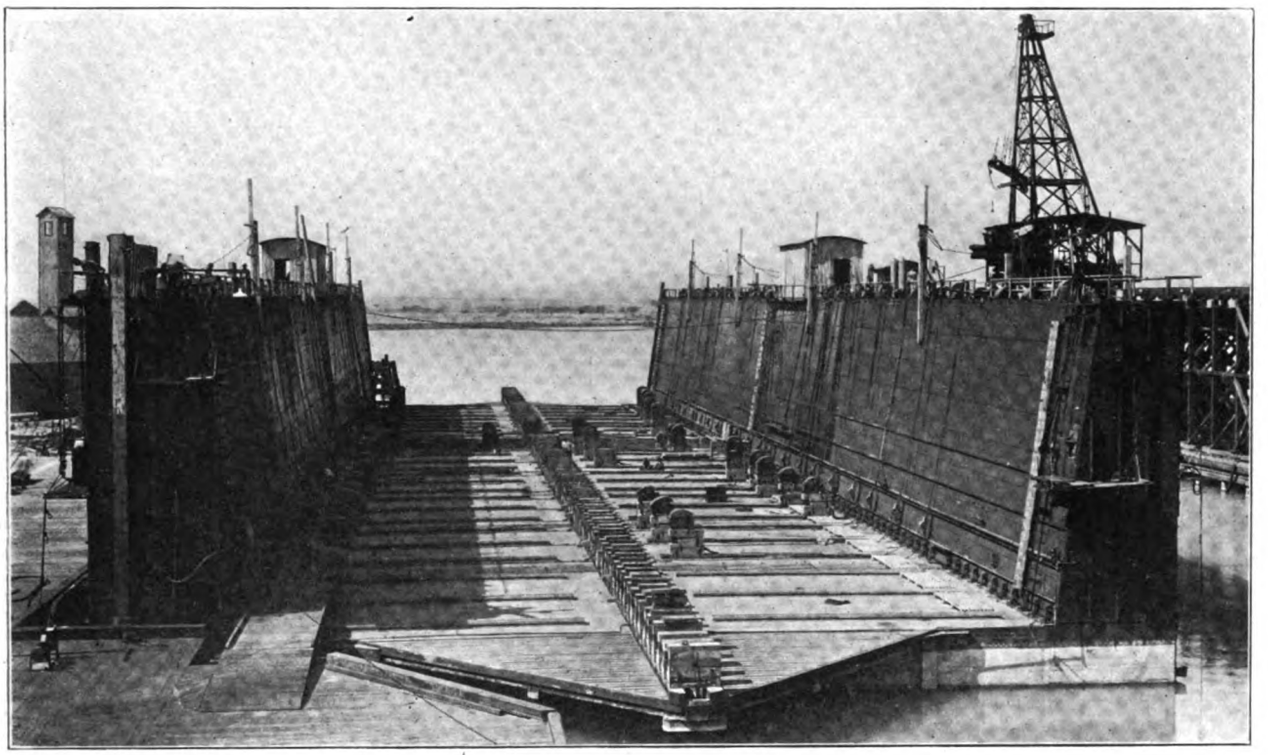

Fig. 2.—Honolulu Dry Dock Pumped Up Light

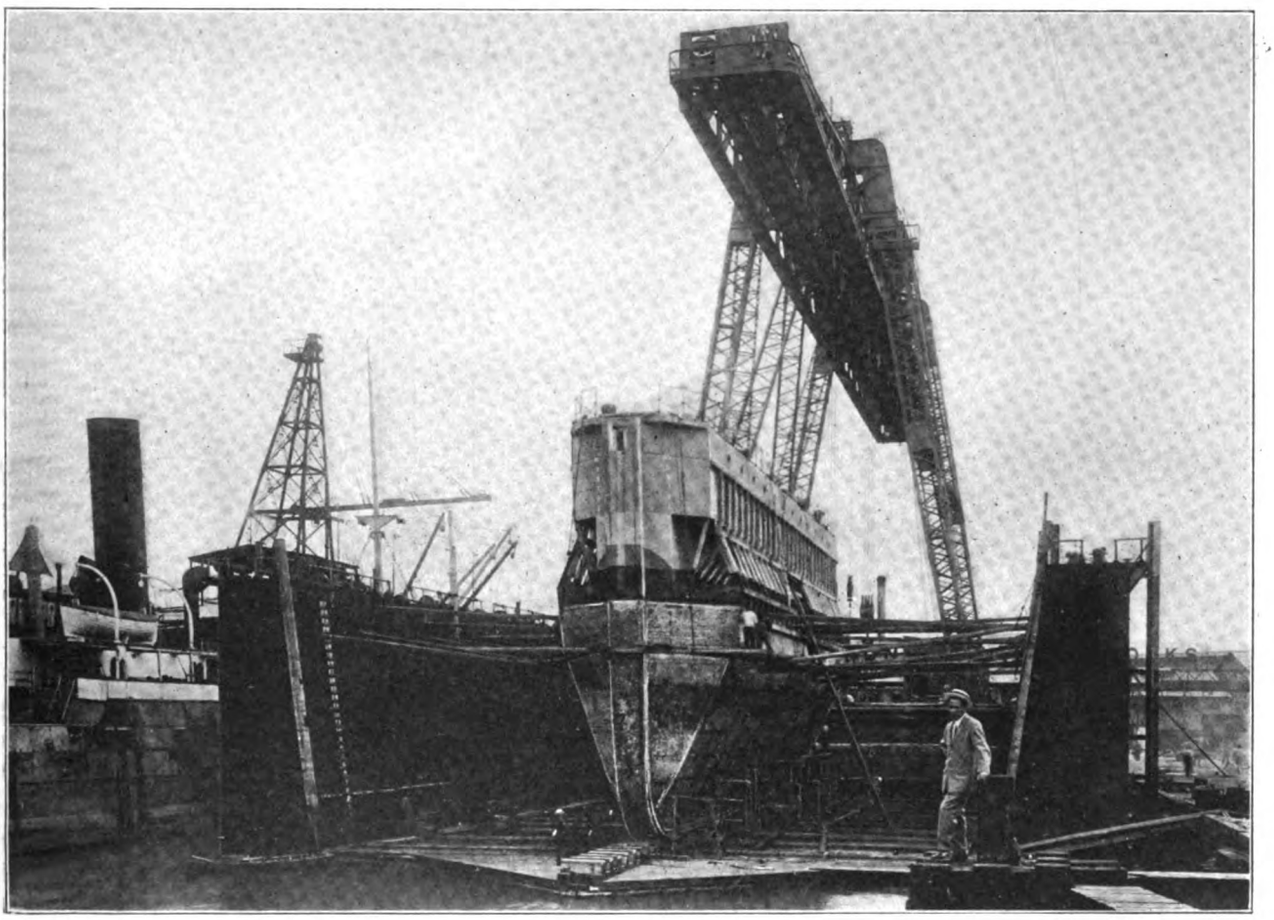

Fig. 3.—Caisson for Pearl Harbor Dry Dock and a 150-Ton Floating Crane Docked at the Same Time in the Honolulu Dry Dock

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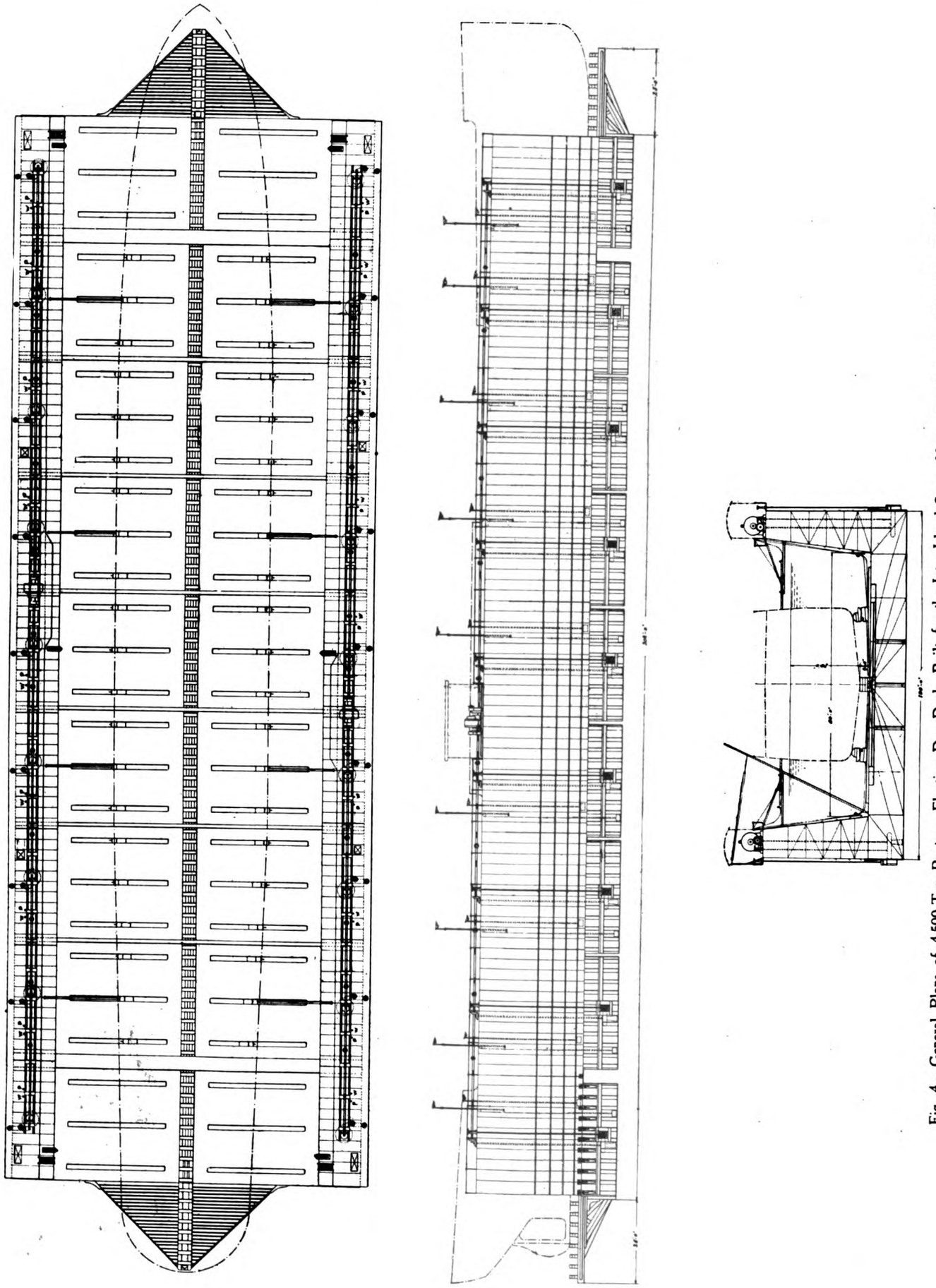

Fig. 4.—General Plans of 4,500-Ton Pontoon Floating Dry Dock, Built for the Inter-Island Steam Navigation Company, Honolulu, T. H.

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in lifting power, not only by increasing its length but by substituting for the central portion of the dock deeper pontoons, thus concentrating the lifting power towards the center for heavier vessels.

The pumping machinery is operated by electricity supplied by the Hawaiian Electric Company over special duplicate feeder cables, to avoid the possibility of interruption of service. The pumping is by centrifugal pumps, there being eighteen 10-inch pumps, one in each end of each pontoon. The group of nine pumps on each side of the dock is operated by a 200-horsepower motor. These motors are controlled from a station on the pier near the shore end of the dock, so located as to be closely in touch with the dock master directing the raising of the vessel. All the machinery is of special design and made of unusual weight and strength to insure absolute reliability.

The pontoons are each 100 feet in length, corresponding to the width of the dock, 32 feet in width, corresponding to the length of the dock, and 10 feet in depth. They are built of selected Oregon pine and for protection against teredo are copper-sheathed over felt.

The steel wings are 30 feet in height, 12 feet wide at the base and 8 feet at the top, and are built continuous, connecting all the pontoons rigidly together. The attachment between the wings and pontoons is such that any pontoon can be readily detached and separated for dry docking on the rest of the dock. The steel for the wings was furnished by the United States Steel Company, fabricated in the Ambridge shops near Pittsburg, and shipped from New York by the American Hawaiian steamers.

The building of the pontoons was under the direction of Jas. A. Lyle, and the construction and equipment of the dock was carried out under the very able management of Jos. E. Sheedy, general superintendent of the company.

The dock was completed in about one year, and the first vessel raised on November 11, 1913. Since that time the dock has been constantly in use overhauling the company's vessels, and twice has raised the steamship *Wilhelmina*, of 6,974 tons register, a sufficient distance to enable a propeller blade to be replaced.

Fig. 2 shows the dry dock pumped up light. The location of the dock in Honolulu Harbor is such that it is close to the Honolulu Iron Works, which is equipped with a large machine shop and foundry facilities. Arrangements have been made between the two companies to handle ship repair business in the most rapid and economic manner.

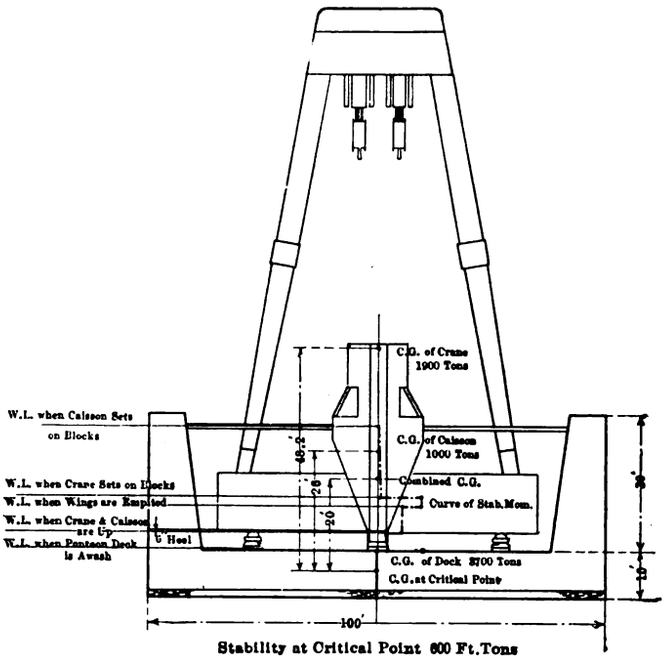
On April 9 the Inter-Island Steam Navigation Company carried out what was probably the most unique and difficult piece of dry dock work ever performed by a floating dry dock. This was dry docking at one time the United States 150-ton floating derrick and the caisson for the Pearl Harbor dry dock. These two structures are as divergent in character and proportions as it is possible to conceive. The 150-ton floating derrick has a displacement of 1,900 tons, a length of 125 feet, with a beam of 75 feet and a draft of 10 feet. The caisson is 127 feet long, 20 feet beam, and has a draft of 26 feet. The center of gravity of the floating crane is 32 feet 6 inches above the water, and the center of gravity of the caisson is necessarily much below the waterline.

As the floating dry dock was limited to a draft of 24 feet it was only possible to dry dock the caisson by partially raising it with the floating derrick, thus decreasing its draft to 23 feet 6 inches. The two structures were then floated into position in the dry dock and the dry dock pumped up sufficient to ground the caisson upon the blocks, after which it was shored in an upright position from the steel wings. The pumping was then continued and the floating derrick finally landed upon the blocking.

The confidence of the Inter-Island Company is shown from the fact that this docking was carried out between dark and midnight on account of the high tide coming about dark. Figs. 1 and 3 show this huge structure towering above the deck of the dock. The height of the top of the truss is 125 feet above the deck of the dock and its length 290 feet.

By referring to Fig. 5 there will be seen a stability diagram which was worked out before this dry docking was undertaken to show the stability of the dry dock when handling these structures. From this it will be seen that the combined metacentric height at the critical point was 10.8 feet, corresponding to 600 foot-tons righting moment.

A longitudinal view shows how the longitudinal stress can be distributed by pumping in a pontoon dry dock. From this



Stability at Critical Point 600 Ft.Tons
Metacentric Height at Critical Point 10-8 Ft.

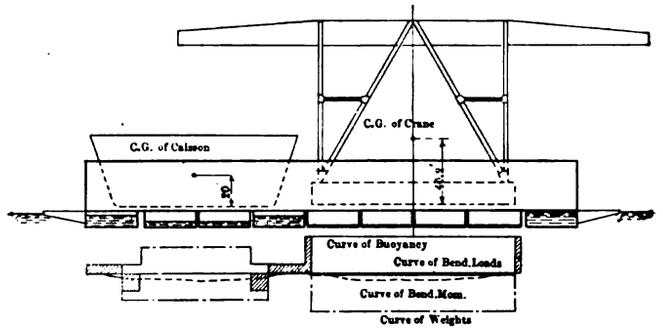


Fig. 5

it will be seen that the pontoons immediately under the weights are pumped, while those not carrying weights are left wholly or partially full of water, the result being that longitudinal stresses due to uneven loading are practically eliminated, the maximum stress in the steel wings due to loading being 0.35-ton per square inch.

When it is understood that this dry dock had been in operation only a few months and was being handled by parties previously entirely unfamiliar with floating dry docks, its great reliability will be appreciated.

LAUNCH OF THE BISMARCK.—The new Hamburg-American liner *Bismarck*, 955 feet long and 100 feet beam, a sister ship of the *Imperator* and *Vaterland*, was launched at the yards of Blohm & Voss, Hamburg, Germany, June 20.

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Westinghouse Turbine Reduction Gear

Special Features of the Westinghouse Reduction Gear—Construction of the Floating Frame—Measurement of the Power Transmitted

Most of our readers are probably familiar with the general principle of the Westinghouse reduction gear, manufactured by the Westinghouse Machine Company, East Pittsburg, Pa., as the installation of this gear on the United States naval collier *Neptune* has been fully described in previous issues of this journal. Briefly the gear consists of a floating or movable frame, such as is shown at A, Fig. 4, which carries a double helical pinion in rigid bearings, the frame A having freedom, however, to adjust itself in the horizontal plane perpendicular to a plane passed through the center of the shaft

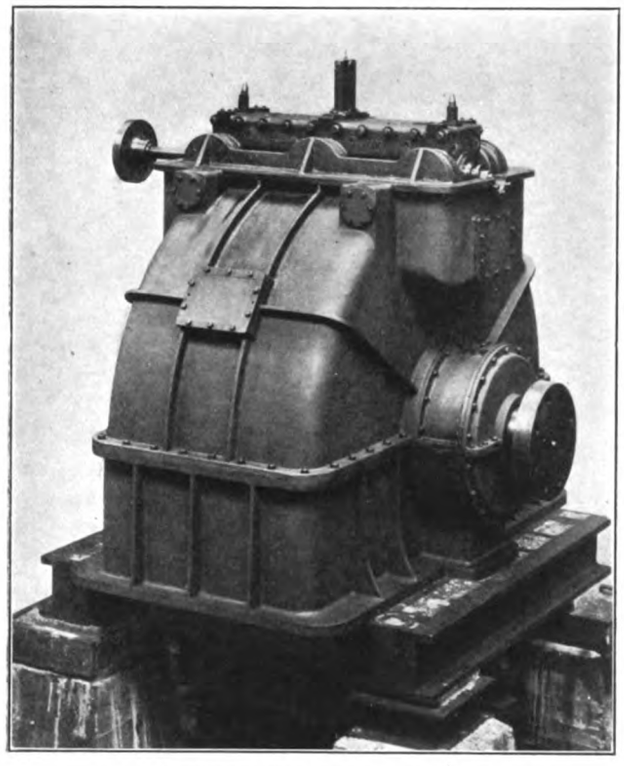

Fig. 1.—Reduction Gear Assembled

and the nominal center of the pinion and thereby permitting the pinion to assume a natural deflection in accordance with the load being transmitted.

In order to avoid having the weight of the pinion and pinion frame coming on the teeth of the gear and pinion, the frame A is supported on struts BB held in adjustable sockets DD, which permit the vertical distance between the center of the pinion shaft and the gear shaft to be accurately adjusted, and to prevent the radial component of the pinion thrust lifting the frame from between its thrust abutments, a second set of adjustable struts CC and accompanying adjusting screws EE are provided, thus preventing the pinion shaft from moving away or approaching the gear shaft, but permitting motion in the horizontal plane. The struts and floating frame are shown in detail in Figs. 4 and 5. Oil for lubricating the pinion bearings and pinion gear is supplied through the opening H, which communicates through a sliding contact I, Fig. 4, which communicates with the port J extending the length of the pinion frame A, Fig. 4. A spray of oil floods the pinion through the ports KK and also supplies the bearings at the center line, or point of minimum pressure.

When a bearing rotates under load, unless metallic contact occurs, oil supplied at the point of minimum pressure of the bearing is carried around by the journal friction and the pressure of the oil film at the point where the load is carried must be sufficient so that the oil pressure times the bearing area is equal to the load on the bearing; otherwise the oil film would be destroyed and metallic contact would ensue as a result. By providing outlets at the point of maximum pressure, a bearing within the limits of its capacity may be employed as a pump, and this is what is done in the Westing-

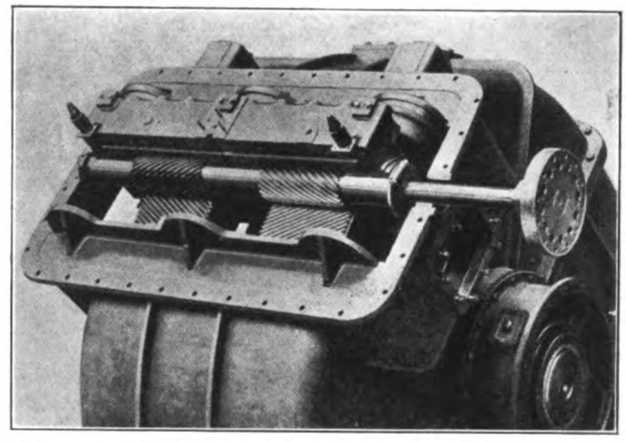

Fig. 2.—Pinion Frame Cover Removed

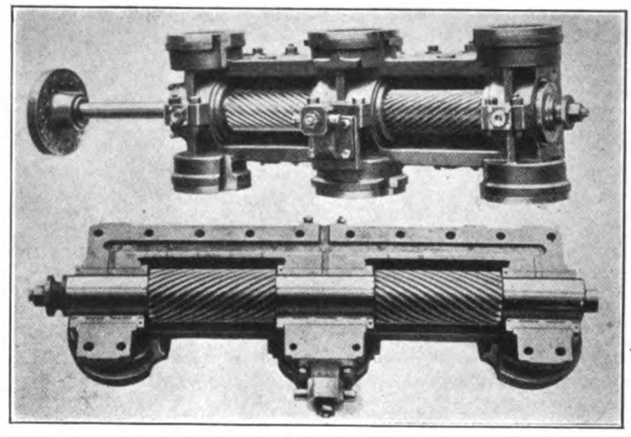

Fig. 3.—Pinion and Frame

house reduction gear, recesses being provided in the bearings at the point of maximum oil pressure in the bearings, which communicate with passages L, Fig. 5. A ball check valve M is provided in each passage L, through the bearings, and each of the passages L communicates through this check valve with a common space N, which is connected by passage O to the space behind the piston V. The total area of the pistons V is made approximately twice the projected area of the bearings, and hence an oil pressure of approximately one-half that of the oil firm in the bearings if exerted on the pistons V, is sufficient to balance the thrust of the pinion; thus as the pinion revolves under any given thrust, oil from the bearings at the pressure of the oil film in the bearings is pumped through the passages L to the space N, and through the holes

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O to the pistons V, balancing the movable or floating frame A, carrying the pinion in the direction of the arrow, or opposite to the direction of the pinion thrust, until the opening in the passage E, in the arm of the floating frame moves away from the movable seat Q sufficiently to permit the excess oil pumped by the bearings to escape and thus relieve the pressure behind the pistons V until the product of the area of the pistons into the oil pressure is just equal to the total thrust

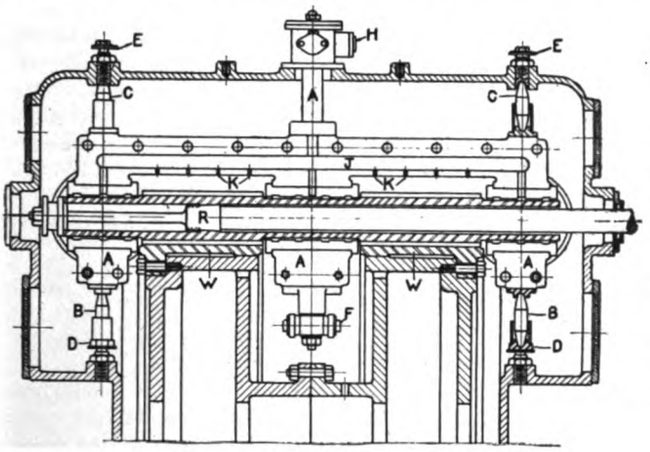

Fig. 4

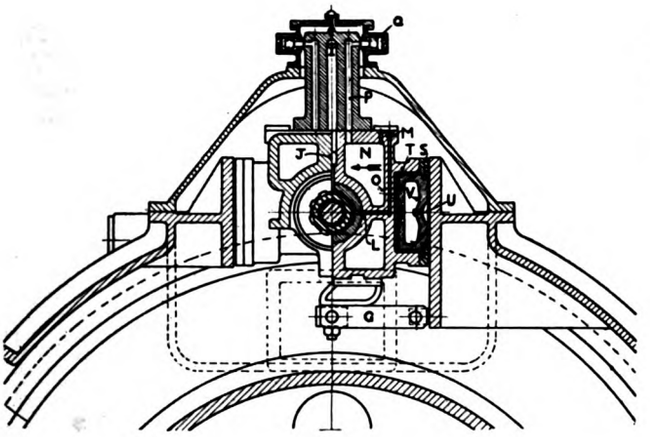

Fig. 5

on the pinion. Should the load increase, there is a tendency for the frame to be pushed over against the oil pressure behind the pistons V, and this brings the frame arm against the movable seat Q until the oil pressure behind the pistons again builds up sufficiently to balance the increased thrust; or if the thrust on the pinion decreases, the opposite action will take place. The seat Q is circular and has a shoulder which engages with the housing containing it, and it is held outward by a spring, thus forcing it in contact with the pinion frame arm until the frame takes the central position. This is made so that the frame normally when under no load can move back until the frame arm comes in contact with the gear housing. To prevent the pinion frame from tipping when the frame arm comes in contact with the housing, fulcrum F and fulcrum link G are provided which flexibly tie the floating or movable frame to the gear housing, as shown in Figs. 4 and 5.

Referring to Fig. 4, it will be noted that the pinion drive which passes through the hollow pinion is connected to it by a taper fit and circular keys at the point R in the middle of the after pinion. This reduces considerably the total torsional deflection of the pinion under load.

The gear wheels are made of cast iron with cast steel rims pressed on, as shown at WW, Fig 4. The steel castings from which the gear rims are made are cast two or three times the thickness of the finished rim and with a riser somewhat more than the width of the rim attached. The material used for the rims is mild steel, having an ultimate tensile strength of about 60,000 pounds, and an elastic limit of about 35,000 pounds.

Fig. 1 shows the gear and floating frame assembled complete ready for the pinion frame cover. The gages shown are for indicating the oil pressure behind the ahead and astern floating frame pistons respectively, and the pressure indicated on these gages multiplied by the area of the floating frame pistons in square inches gives the total effective thrust on the pinion, and this into the peripheral speed of the gear divided by 33,000 is the shaft horsepower transmitted. Experience has shown that the power transmitted is measurable, by this means with an error of less than one percent, so that the need of a torsion dynamometer on the propeller shaft is obviated. By connecting the oil pipes from the floating frame to recording gages and using recording tachometers, it is possible to keep a continuous record of the shaft horsepower developed. A special form of differential pressure gage may also be used which will record the horsepower direct.

The British Board of Trade Experimental Bulkhead Tank

Following the *Titanic* disaster, the British Board of Trade appointed a special departmental committee, with Sir Archibald Denny, Bart., as chairman, and Professor Welch, of the

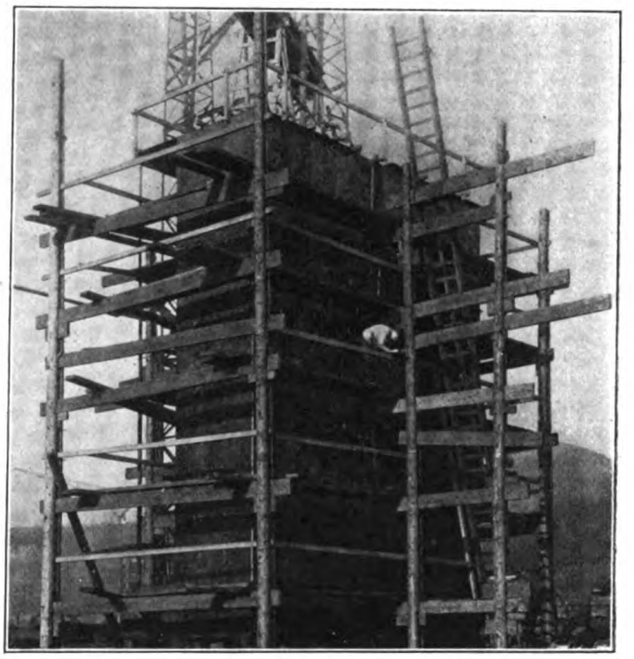

Fig. 1.—General View of Bulkhead Tank

Armstrong College, Newcastle-upon-Tyne, as secretary, to inquire into the whole question of bulkhead construction.

This committee arranged for the building by Messrs. Swan, Hunter and Wigham Richardson, Limited, of Wallsend-upon-Tyne, of the experimental tank illustrated in Fig. 1. This structure is about 35 feet in height, 26 feet from side to side, and there is a distance of about 6 feet between the front and rear bulkheads. The bottom portion of the tank extends an additional 4 feet, so that the structure has a total width at the base of about 10 feet. On one side of the tank there

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are three decks, 4 feet wide, thrown out and the spaces between them represent a ship's hold and two 'tween decks.

The plating of this tank was carried out partly in vertical strakes and partly in horizontal strakes. The stiffeners used both inside and outside the tank were of various sections, and in different places flanged plates, plain angles, bulb angles or channel bars were used. The design of the end attachments of the stiffeners also varied, for in some places angled lugs were used and in other places knees. Furthermore, these lugs and knees were of different sizes. In some cases no attachments were made at the ends of the stiffeners.

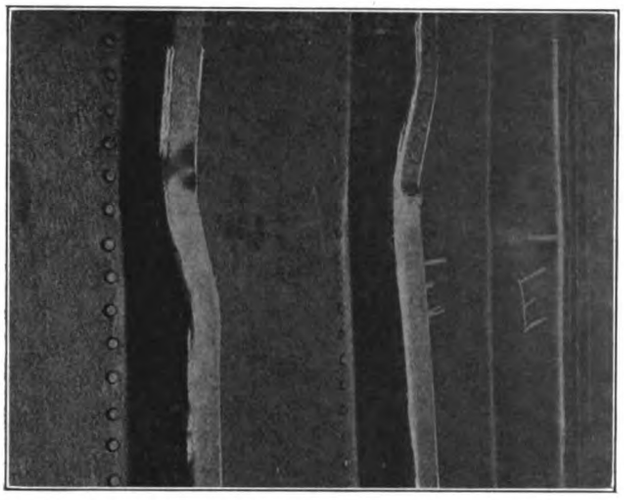


Fig. 2.—Effect of Water Pressure on Bottom of Tank

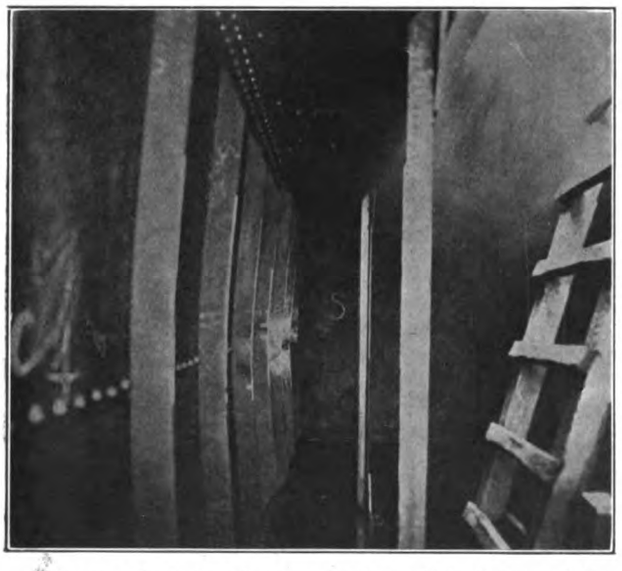


Fig. 3.—Vertical Stiffeners and Plating Bulged Outward by Water Pressure

The tank was equipped by Messrs. Swan, Hunter and Wigham Richardson, Limited, with water gages, and there is a service of pipes, so that the tank may be filled with water. During the experiments made by the bulkheads committee a much greater "head" or pressure of water was used than is ever likely to occur in an actual ship at sea, and in Figs. 2 and 3 are shown the vertical stiffeners and plating bulged outward by the pressure of water, and also the effect of the water pressure on the bottom of the tank, with the angle bar stiffeners bent and showing signs of fracture.

The bulkheads committee report to the Board of Trade will be published shortly, and meanwhile it is not desirable to publish further details or tables of the results arrived at during the recent series of exhaustive tests.

Motor-Driven Tank Vessel Avon

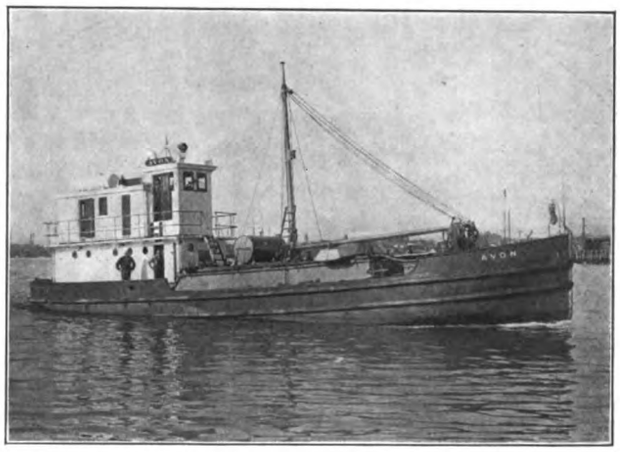
The most recent addition to the large oil-carrying fleet of the Associated Oil Company, of San Francisco, is the new steel tank vessel *Avon,* built to deliver refined oil from the refinery at Avon, California, to the different distributing stations about San Francisco Bay. The vessel is built of steel, and, on account of having to navigate shallow water, she has been built with a square knuckle at bilge. This formation has been carried around the stern, the propeller and shafting being supported by a skag.

The principal dimensions are as follows:

Length over all	81	feet	6	inches
Length between perpendiculars	74	"	6	"
Breadth, molded	16	"	0	"
Depth, molded	5	"	9	"
Mean draft with 20,000 gallons gasoline (petrol)	4	"	6	"

There are five athwartship bulkheads, and one longitudinal bulkhead at the center line of the ship, forming four cargo tanks. There is also a small hold forward for carrying drums and other miscellaneous cargo.

The engine room is aft, as are also the accommodations for the crew of five men. For a vessel of her size the machinery outfit is very complete. The engines were built and installed by the Union Gas Engine Company, of San Francisco. The main engine consists of an 80 horsepower three-cylinder Union engine of the open crosshead type, driving a four-bladed propeller. The engines used for pumping the cargo are two 12-horsepower double-cylinder Union engines driving rotary pumps by means of silent chain drives. One of these engines is also connected to a rotary pump for fire and bilge pump service. There is also a 6-horsepower Union hoist on this vessel, used for handling freight. The electric lighting system, including the ship's lights and a powerful searchlight, is supplied from a 4-horsepower Union single-cylinder electric lighting engine, direct-connected to a 2-kilowatt Westinghouse generator. With the heavy flywheels and flywheel governor on this outfit, an absolutely steady light is maintained without the use of storage batteries. The propelling engine is arranged to be controlled from the pilot house, in order that one man may handle the ship.



The *Avon*

On her trial trip a speed of eight miles per hour was attained.

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How Marine Engineers Can Make Money—I

"Old Scotch," the Sage of the Engine Room, Shows How the Men Below the Gratings Can Add to Their Income

Brother marine engineers, anywhere and everywhere, how would you like to make an agreement with the owners of your ship so that beginning, say, on August 1 next, they would give you half the price of all the coal you saved for the next six months when compared to the amount you used during the preceding six months?

Say that you are on a ship making regular runs, using about five hundred tons a month, or three thousand tons for a period of six months, and by watching the corners carefully you cut down the fuel consumption only 10 percent, that would be a saving of six hundred tons. Half of this capitalized at $4 (16/8) per ton would mean a cash dividend to you amounting to $1,200 (£246) and the same amount to the owners. Not so bad to take, eh?

Of course, if you are the chief engineer you are not going to hog the whole amount. You will "divvy" it up judiciously with your assistants, your oilers, water tenders, firemen, and even the meek and lowly "snipes," so that every man jack of them would have an interest in the rake-off. If you didn't divvy it up let me say right here that you wouldn't make much of a record for economy during the next six months period.

Such a proposition as this saving-sharing may sound a little pipe-dreamish, but it has been done in lots of shore plants, and unless I miss my guess it won't be long before it is put in practice on board many steamships. It is a good thing for both of the interested parties, as they each profit by it. In these days of active competition and high prices the corners will have to be watched mighty carefully to break even on any kind of an investment. The cost of living still stays way up, wages are none too high now, so about the only thing left to economize on in steamship operating is the coal pile. Hence it is that all the inventors and engine designers are engaged in a mad race to get up the most economical method of propulsion, and we hear of internal combustion engines, electric drive, hydraulic transmission, turbines with and without reduction gears, combinations of reciprocating engines and turbines, and so on ad libitum. All have one object in view, and that is to reduce the fuel bills. Go to it, inventors and designers, and get up the most economical ship-driving apparatus you can. In the meantime those of us who have to drive the old-fashioned mills will have to do the best we can, and at that I believe there is lots of room for improvement and saving. We cannot very well alter the designs of the ships' machinery we are now running, but we can alter and improve our methods, which will perhaps save as much fuel as can be saved by improvement in designs.

But, you are saying, how are we going to save that 10 percent in the coal bills? All of us old-timers have, I am afraid, been lulled into the belief that the old three-cylinder triple we are running is just about the most economical machine that ever was. We get this belief quite naturally, as when we were youngsters and the first compounders were coming into use we thought they were the real things for coal saving. Along in the eighties the first triples appeared and then we were quite sure that we had arrived at the genuine all wool and a yard wide coal savers. Compared with the old single mills our daddies ran they are sure enough very economical pieces of mechanism. But as the old darky philosopher said, "The sun do move," and so does the world, but many of us have been standing still, so far as fuel-saving is concerned. What used to be a good record years ago would be looked upon as extravagant and wasteful nowadays, and to keep up with the times we have got to look into the new methods pretty carefully.

Do you know what "thermal efficiency" means? Well, I'll tell you, as I have just been put wise to that term myself. You can appraise coal nowadays just about the same as they appraise gold quartz. The only thing that interests a gold miner is how many dollars' worth of gold there are per ton of ore as taken out of the mine. With coal the question is how many British thermal units does it contain? Those are the things which make steam, and that's all we are interested in. Coal, such as we get on board our ships, contains all the way from 11,000 to 15,000 British thermal units per pound. A British thermal unit, you know, is equivalent to 778 foot-pounds of work, and if you want to take the trouble of figuring it out you will find that 1 horsepower is the equivalent of 2,545 British thermal units.

Old Scotch

With a good grade of coal, containing, say, 14,000 heat units per pound, you can see that if all of them were converted into horsepower at the engine our coal bills would be very small; but here's the rub, the great bulk of these heat units gets away from us without doing any useful work. This "thermal efficiency" means the proportion which the number of heat units turned into work at the engine bears to the total number of heat units in the coal shoveled into the furnaces. It may surprise you to know that about the most economical record ever made, using steam as a medium, has about a 19.4 percent thermal efficiency, and it is safe to say that the best record that the triples you and I are jockeying every day have a thermal efficiency of not more than 12½ percent at the very best. In other words, for every eight shovelsful of coal we are putting into the furnaces, seven of them might as well be thrown overboard, so far as this "thermal efficiency" stunt is concerned. The problem before us is, therefore, to corral some of these wandering thermal units and put them to work in order to make that 10 percent saving in the coal we are now using. If the editor will allow me, I'll try to show in the next issue where some of them at least can be saved from wandering.

Yours for economy,

Old Scotch

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The Rational Non-Diesel Marine Oil Engine

BY ALBERT H. ZIEGLER

The requirements for the design and construction of such an engine as was outlined in the last instalment of this article would be as follows: All portions of the interior of the combustion chamber should be water-jacketed. No hot bulbs, tubes or plates should be used. In large units, for deep sea, heavy-duty work, the engine should be directly reversible and equipped for starting on compressed air at pressures not over 50 pounds per square inch. As at least a warm combustion chamber is necessary for preventing the condensation of an atomized fuel charge, provision should be made for starting the engine without resorting to gasoline (petrol). This can be accomplished by previously heating the jacket water in a small, simplified, blow-torch heated boiler in thermo-syphon communication with the jackets of the cylinders and cylinder heads. In addition, the initial air charges upon starting the engine can be drawn hot from the same heater or boiler. Once having started, however, all succeeding air charges to the cylinder should be of the same temperature as the outside air. No heat should be imparted to the subsequent charges until they are inside the engine cylinders, thus insuring a maximum volume of charge and a high mean effective pressure.

The vacuum in the inlet pipe up to the inlet valve seat should be as low as large pipe sizes will allow, being not over ½ pound gage corresponding with a velocity of about 70 feet per second. The oil fuel should be atomized directly at the inlet valve seat. No compressed air should be applied for atomizing, as compressed air in expanding would produce a refrigerating effect, increasing the viscosity and vapor tension of the oil fuel, and making its complete atomization more difficult. Before being atomized the fuel oil should be heated almost to its "cracking" point to decrease its viscosity and vapor tension, and therefore aid complete combustion by being passed through hot portions of the cylinder head. In order to completely atomize oil fuels at the lip of the inlet valve by means of the air velocity, a comparatively high velocity is required varying according to the density and viscosity of the fuel used. With solar oil preheated as prescribed, a velocity of about 170 feet per second is required past the oil spray holes or tubes. Coal oil would require a velocity of from 190 to 200 feet per second, as would heated oils of heavier weight.

Means must be provided for controlling the quantity of fuel supplied in proper proportions for all loads and speeds, and also for assuring a constant velocity past atomizing tubes at all engine speeds. A constant richness of the fuel charge is not suitable for varying rates, as the charge should be slightly richer at light loads than at heavy loads on account of the higher compressions attained at heavy loads. A mechanically operated inlet valve having a uniform lift at all loads and speeds would not produce a uniform velocity past the valve seat for oil atomizing. The velocity would vary in direct proportion to the engine speed. If the atomizing velocity were correct for high speed the fuel would not be properly atomized at low speed, and the engine would not be flexible. A mechanically operated inlet valve with a variable lift, acting as a throttle, would reverse the range of velocities, giving a much higher velocity at low engine speed than at high speeds. A separate throttle in the inlet pipe, acting in conjunction with the variable lift inlet cams of link motions, might be so adjusted as to produce a practically uniform velocity past the valve seat, but the resulting complication of the variable valve lift and throttle mechanism would hardly prove justifiable. A throttle in the inlet pipe, acting entirely independently of properly-designed light, automatic inlet valves, equipped with dash-pots at the end of their stems, would undoubtedly prove the simplest means for insuring an entirely uniform velocity for oil atomization at all loads and engine speeds.

If the engine were running at full load, and at high speed, with the throttle wide open and the inlet valve spring tension adjusted so as to produce the proper atomizing velocity past the valve seat, that velocity will remain constant at all the other speeds, however much the vacuum between the throttle and the inlet pipe may be increased, due to throttling of the engine. This is true because the velocity of a gas through an aperture is dependent upon the ratio of the pressures on both sides of that aperture, whether the pressures involved be high or low. In other words, the velocity would be as high through any aperture with a pressure of 2 pounds absolute on one side and a pressure of 1 pound absolute on the other side as the velocity caused with a pressure of 1,000 pounds absolute on one side and of 500 pounds absolute on the other side. The ratio of the pressures is the same in each case; that is, 2 to 1. In the case of the automatic inlet valve, set to require a definite ratio of absolute pressures above and below it to lift the valve off its seat, reducing the pressure above the valve by throttling, requires a reduction of the pressure below by the action of the engine piston, the valve not opening until the proper ratio between the pressures is established and flow velocity will be the same as when no throttling existed.

Though the velocity of flow remains constant, the volume of flow is less when throttled as the density of the charge is reduced by rarefication. For a different richness of the explosive charge the amount of fuel atomized into such a rarefied air charge should be proportionately reduced. The atomizing nozzle should be so designed as to pass the air at its highest velocity squarely across the nozzle. The lip of the nozzle should be gradually expanded in a conical or other shape, such as will spread the fuel out in a very thin film before subjecting it to the atomizing process on the edge of the nozzle. By means of inclined vanes or fins in the throat of the inlet valve, the incoming air charges may be given a radial motion which continues for an appreciable time after the charge has entered the cylinder, tending to mix the air and atomize the fuel more intimately and preventing stratification.

If the engine is started up under heavy load, no water need be used in the cylinder until the engine has become heated up appreciably. Under less than about 40 percent load it is seldom that any water need be used with most oil fuels. When the load exceeds 40 percent of the rated output, however, the need for more or less water in the cylinder becomes apparent. This water supply, as well as the fuel supply, should be accurately proportioned, according to the change of load on the engine, and should be as finely atomized or subdivided into the charge as is the fuel. As nearly all water contains various quantities of mineral matter, either in solution or in suspension, it is advisable, in order to prevent the accumulation of such matter in the engine cylinder, to arrange for distilling the water required.

There have been instances where the exhaust heat of an engine was used in a very simple form of evaporator, and about 1½ pounds of water per horsepower-hour were thus evaporated. As oil engines require about as much water in the charge as the fuel consumed, the exhaust heat is, therefore, abundantly able to evaporate much more than would be required. By depending upon the distillation process for this water, it would be unnecessary to provide tank capacity for carrying the water on board ship, which would be a considerable saving of space. Such water could also be distilled from the salt water in the cylinder jackets, which is heated to about 160 degrees F.

If it is attempted to pass the steam from the evaporator directly into the cylinder, care should be taken that such steam is cooled to the saturation point; that is, until it is just ready

* Concluded from the June number.

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to re-condense; for steam is really a very dense fluid matter and takes up a good deal of space. Unless cooled to a state practically bearing on nearly atomized water, the quantity required in the cylinder at each charge will crowd out just so much explosive mixture as is represented by the difference between its volume in the shape of steam and its volume in the shape of water. For reliability of operation it would probably be better to entirely condense the steam; pass it to atomizing nozzles at the seat of the engine inlet valve at a temperature of about 200 degrees F., when its vapor tension is very low, assuring ease in atomizing.

The compression pressures carried in such engines depend upon the chemical composition of the fuel used and upon the amount of atomized water used in the charge, but past experiments along this line have given abundant evidence that compressions of 250 pounds and upwards may be easily and reliably attained in such non-Diesel engines. The consumption of fuel per brake horsepower-hour will, of course, be greatly affected by the degree of compression carried, a low compression resulting in a higher fuel consumption than very high compression. It is due to the very high compressions carried in the Diesel engine, which are so necessary for their correct operation and for self-ignition, that the fuel consumption of such engines is so remarkably low, although it might be reasonably suspected that if Diesel engines could be operated under lower compressions than 450 to 500 pounds the resulting ease and cheapening of manufacture and of upkeep gained might be more of an inducement to manufacturers and purchasers than the slight difference in fuel consumption involved.

It would perhaps be demonstrated after trial and experiment that the compression pressures advisable in the type of non-Diesel engine above described would vary according to the density and composition of the oil fuel in each case, just as compressions advisable are found to vary in engines burning gasoline (petrol), city gas, natural gas, blast furnace gas and alcohol, though with the different grades of oil fuels it is very probable that the range of compressions would not vary to such high limits.

Care of the Electric Plant on Board Ship

Care of Switches, Plugs and Fuses—Troubles to Look for and How to Remedy Them

BY SIDNEY F. WALKER

One rule may be given in connection with switches that are used on board ship; always have them as large as possible. No rule can be given as to the extent of switch surface per hundred amperes of current, as is usually given. Ship work is quite different from any other; and even on shore, the switches are very often too small. The only rule that is at all applicable is: have the switches, the circuit breakers, the wall plugs, everything except fuses, as large as space and funds will allow.

SWITCHES

The writer had a very interesting experience a good many years ago, in connection with colliery work. He has a large experience with colliery work, and with ship work; and he has found that the conditions applicable to the two are to a large extent similar. In the early days of electric light and power work in collieries, the switch problem was a very troublesome one. Mine owners would not pay for substantial switches; but in many cases the colliery mechanics made switches themselves; and when they did, they made them in colliery fashion; very rough, but with plenty of material; and they stood better, far better than any of the switches made by the best firms in the trade at that time.

The great point to bear in mind about switches is: that as large surfaces as possible should bear against each other at the actual switch contacts. Modern switches are turned out very much better; the machinery is far superior to that of twenty years ago; and the bearing of the two sets of contact surfaces upon each other, when the switch leaves the factory, are far better than they were in those days. But immediately a switch is taken into service all sorts of things come against it. There is the wear of the two surfaces, as the switch is thrown in and out, and, what is of far more importance, there is the spark which passes between the contacts whenever the switch is opened. This spark carries a small quantity of the material of which the switch is made, usually brass, from the positive side to the negative, and sometimes to the contact bar. The modern switch is made to break very quickly, so that the spark is the smallest possible; but it sometimes happens that the spring of the switch becomes weak; it may be exposed to heat, especially in some places where it has to work on board ship; and then the contact bar will not leave as quickly as it should do, and the spark may be followed by an arc.

Every switch on board the ship should be carefully examined as often as possible; and the larger the current controlled by the switch, the more frequent should be the examination. Every sign of wear should be promptly removed, and the surfaces made good. Every sign of a weakening spring should be promptly made good. It is not difficult for marine engineers to replace the springs that are used to bring the contact bar away from the contacts, and it is not difficult to carry spare switches. The slightest sign of wear or of fusing at any one of the switch contacts should be immediately attended to. It will be wisest to replace the switch by a spare one, and carefully overhaul the damaged one at leisure. The small switches that are employed to control single lamps usually stand very well, but there is always the danger on board ship of salt having deposited upon some of the contacts or upon the terminal screws, or upon the wires connecting them, and it will therefore be wise to examine these periodically, and to clean off any green deposit that is formed.

PLUGS

Where wall plugs are employed for portable lamps they should receive the greatest care, and should be overhauled very frequently indeed. It will very often be found that the female portion of the plug, whether it is a two pin or a single pin plug, is dirty. Grease and other dirt may get in while the plug is not in use, and the sparking referred to above will also tend to build up a dirty surface. The female portions, which usually consist of tubes, can be cleaned by means of a piece of emery wrapped round a stick cut exactly to the size.

Flexible cords should also be very frequently examined, and should be tested with the insulation testing apparatus if there is one. Any sign of wearing on the outside of the cord should be promptly suspected, a more careful examination made there, and unless it is very clearly seen that no damage has been done, that piece of cord should be cut out. The cost of a piece of cord is practically nothing compared to the cost of a fire, and a fire may very easily occur if the two flexible conductors in a flexible cord come into contact, making a short circuit. The cord itself is wrapped with

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usually fairly inflammable material, and the heat developed by a short circuit in the cord, under the conditions ruling on board ship, would cause a fire in a very short time.

Circuit breakers, where they are employed, should be carefully examined periodically. They are usually provided with carbon breaks, the spark or arc which passes when the breaker opens being set up between the two carbon surfaces. Naturally the more frequently the breaker is opened the more the carbon is worn, and the carbon contacts should not be allowed to wear very much before they are replaced. It should be understood that in all these matters it is the old tale of the stitch in time. The earlier a trouble of this kind is located, the more easily it is prevented. A little wear is easily provided against, but if it is allowed to go on, the fact of the existence of the wear will lead to greater sparking, greater arcing, and a rapid increase of the wear and of the arcing.

STARTING RESISTANCES

Starting switches and resistances of motors require perhaps greater care and looking after than almost any other switches about the ship. Again, the rule mentioned at the commencement of the article, to have the apparatus as large as possible, is of special importance here. It may and does often happen on board ship that space forbids the use of a large apparatus; in that case, use one as large as can be got in, but so that it can be got at for repairs. See that the contact pieces are large; that there is a large extent of surface of the contact bar bearing upon each contact piece; see that the contact bar bears equally upon each contact piece; and examine the whole of the contact pieces frequently for signs of wear or sparking. Signs of wear or sparking should be immediately made good. The contact pieces should be sufficiently far apart to prevent arcing between two adjacent ones; but not too far apart, or the distance itself may lead to arcing. Modern starting switches are very carefully made, and may be trusted to be all right in that respect when they are sent out; but, as remarked above, from the moment they are put into service, everything tends to put this nice state of things out.

The starting resistance should also be examined at fairly frequent intervals. There is a tendency for the resistance to be too small, and when that is so, or if it is left in connection for too long a time, the connections between the contact blocks and the different sections of the resistance may be broken. Periodical examination will prevent any tendency towards this. On board ship there is also the tendency for a deposit of the salts from the ocean, which, assisted by the current which is passing, will tend to break the connections. Any trouble of this kind may nearly always be seen, long before it does any harm, by the presence of that green powder known in domestic life as verdigris; or in scientific language, one of the salts of copper, either the sulphate or the chloride.

An important caution should be given here; starting switches and resistances should never be employed for regulating the speed of motors. Starting switches and resistances are designed on the understanding that they are only in use, and consequently the current is only passing through them, and particularly through the resistances, for the very short period during which the motor is being started up, a few minutes at the outside. If the resistance is left in circuit, and if the starting switch is left with its contact bar on one of the contact blocks, as it would be if used to regulate the speed of the motor, by varying the resistance of some part of the machine; the resistance, and usually the contact block and contact bar, will heat up. Heat, when developed at any part of the apparatus, except in the lamps, and in the armature of the generator or motor, should be looked upon with suspicion. A hot switch, a hot lamp holder, a hot fuse, should be looked upon with suspicion and promptly overhauled.

FUSES

Fuses stand in quite a different position to switches. The terminal blocks of a fuse must be sufficiently substantial to stand the vibration of the ship, and all that comes against electrical apparatus on board ship, but it is necessary that they should not be too substantial; they should not be too large; because they will carry off a considerable portion of the heat that is developed in the fuse when a short circuit occurs. Under the very best conditions, and with the greatest care, they will carry off a certain portion of the heat; always less in a fairly hot engine room than in some drafty alleyway; but the smaller the amount they can be allowed to carry off, that is to say, the smaller their size, consistent with mechanical strength, the better.

Fuses themselves require careful attention, and very frequent examination. No matter what the metal may be of which the fuse is composed, from the moment it is put into service, oxidation takes place, to a greater or less extent; and the fuse is liable to "blow" with a smaller and smaller current. The enclosed fuses which are now so common are protected to a considerable extent from oxidation; but even with them there is a tendency for the fuse to "blow" with a smaller and smaller current; and they should therefore be examined and changed periodically. With enclosed fuses, and in fact with all kinds of fuses, care should be taken to see that the fuse itself is not broken. The enclosed fuses usually have some indicator to denote when the fuse has "blown"; but all of them do not show when the fuse is broken. Of course, if a fuse is broken, the circuit controlled by that fuse is open. The trouble is that a fuse may go; it may "blow," or it may simply open the circuit without actually blowing; this is possible, owing to the weakening effect that is mentioned above.

The Watertight Subdivision of Ships and the Effect of Bilging—III

BY A. L. AYRE

Fig. 8 represents a vessel damaged at the bows to such an extent as to cause the flooding of No. 1 hold as well as the forepeak. In Fig. 9 the curves of weight and buoyancy for the normal condition are shown by the full lines W and B. respectively, while the dotted curve B_1 shows the amended curve of buoyancy owing to the bilging of the fore end. It is obvious, of course, that the weight curve is the same for both conditions, and we may therefore restrict our attention to the resultant effect of the new form taken by the curve of buoyancy in the damaged condition.

The great change takes place at the fore end, where the bilged compartments are situated, and the only buoyancy remaining is that contained in the cargo and shelter 'tween decks, as shown by the dotted curve. Immediately abaft the bulkhead which bounds the after end of the flooded space, the buoyancy is intact, and at this point, M, owing to the large amount of change in the trim, a huge increase in buoyancy is seen as compared with the original condition. On reference to Fig. 8, where the relative positions of the waterlines are shown, the reason of this great increase is also seen. The difference in buoyancy for the two conditions is now seen to becomes less and less until the point F is reached, where, as seen in Fig. 8, the old and new waterlines intersect each other. and, of course, the amounts of buoyancy at this point are equal. From this point towards the after end of the vessel, owing to the change of trim, the new amount of buoyancy is less than previously existing, as the after end of the vessel has been lifted out of the water.

Fig. 10 shows the curves of *loads* for the original and dam-

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aged condition by the full and dotted lines L and L_1, respectively. The curves of loads which show the variation of positive and negative loading throughout the vessel's length, or the net difference of weight and buoyancy for both conditions, are drawn to show excesses of weight below the base line and excesses of buoyancy above the base line. In this diagram and the new curves of shearing forces, each of which are the integral of the respective curve of loads. A huge increase in shearing force occurs at the after end of the damaged compartments, where the great change in amount of weight and buoyancy takes place (see curve of loads), the new shearing force being more than double that experienced

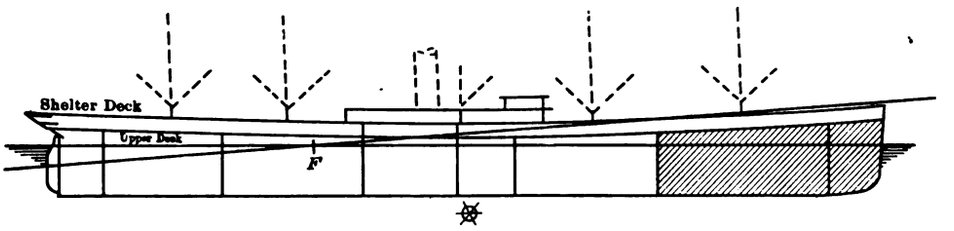

Fig. 8

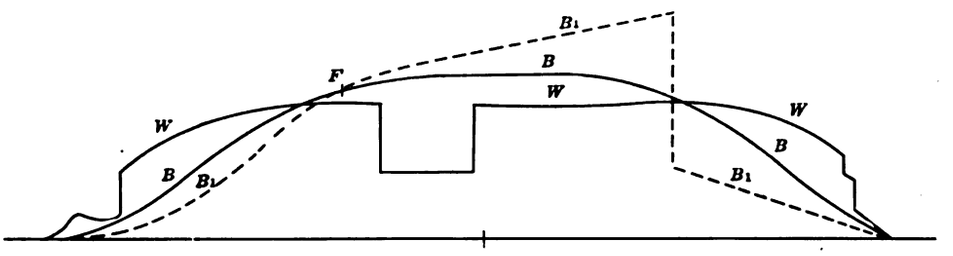

Fig. 9

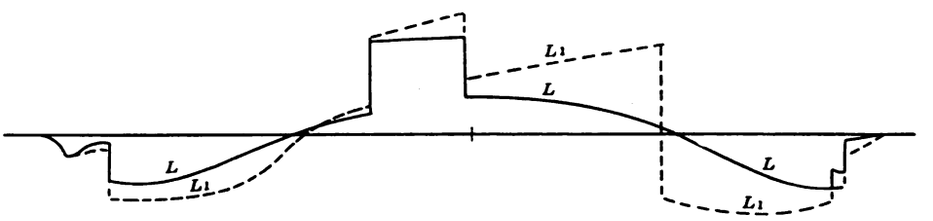

Fig 10

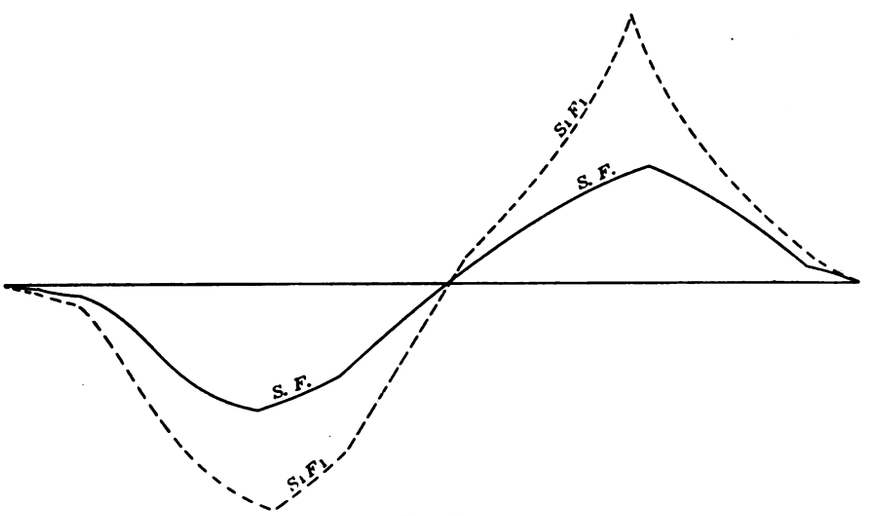

Fig. 11

the new relation of weight and buoyancy is more easily seen, and compared with that previously existing, the new excess of weight, shown below the line, being nearly double that of the old amount, while a proportionate increase is also noticed in the case of the excess buoyancy shown above the line.

The further effect is shown in Fig. 11, where the full and dotted lines S F and S_1 F_1 represent, respectively, the original when the vessel was floating in her normal condition, and in some cases such an increase would no doubt have a serious effect on the vessel's structure.

The effect on the longitudinal bending moment is shown by Fig. 12. The curve of bending moments is the integral of the curve of shearing forces, and owing to the large increase in area in the latter curve for the damaged condition a cor-

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responding increase of bending moment is found. In Fig. 12 the curve for the damaged condition is again represented by the dotted line, and the maximum ordinate is seen to be greatly in excess of that for the normal condition.

It is therefore seen that the resultant effect of bilging on the vessel's strength may be a matter of most serious importance in regard to both the shearing force and the bending moment, and it is quite easily understood why some vessels, as a result of bilging, have broken into two parts before sinking.

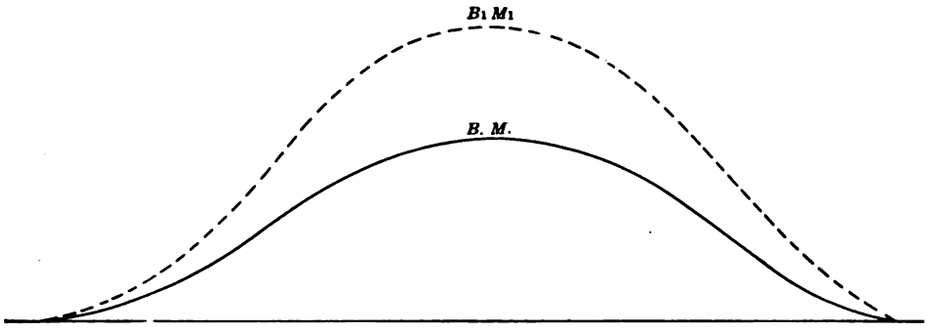

Fig. 12

(*To be continued.*)

Gatun Hydroelectric Development for the Panama Canal

The permanent supply of electric energy for the Panama Canal is generated in the Gatun hydroelectric station, which is located at the Gatun spillway dam. The tremendous water storage in the artificial Gatun Lake, fed by the Chagres River, not only carries vessels the greater part of the way across the Isthmus on a level about 85 feet above the oceans, and provides water for raising and lowering them gently through the Gatun, Pedro Miguel and Miraflores locks, but it also has afforded an excellent opportunity to generate electric curent for lighting the canal, for operating the gigantic gates and other locking machinery, and for the locomotives towing ships through the locks. Electric current will likewise be used for coal handling plants at both ends of the canal, for machine shops, waterworks, drydocks, and possibly in the future for hauling trains on the Panama railroad. To insure continuity of service in case of accident, a steam-electric station at Miraflores, erected a few years ago to supply power for construction work, will be ready to pick up the load when necessary.

The extreme length of the canal is about 50 miles, it has a minimum depth of 41 feet and the channel varies from 300 to 1,000 feet wide. The famous Culebra Cut has a length of about 9 miles. The crest of Gatun Dam has a length of 8,000 feet and an extreme width of 2,100 feet, the height above the normal lake level being 30 feet. There are three double sets of locks at Gatun, one double set at Pedro Miguel and two double sets at Miraflores. The average lift of each set is 28½ feet, the length of each chamber being 1,000 feet, and the width 110 feet. The time required for the passage of vessels through the locks is about three hours, and through the canal from ocean to ocean eight to ten hours.

The complete equipment for the power and distribution system on the canal comprises a 7,500 kv-a., 2,200 volt hydroelectric power plant at Gatun; a 4,500 kv-a., 2,200 volt Curtis turbo-generator electric power plant at Miraflores for emergency; a double 44,000 volt transmission line across the Isthmus, connecting Cristobal and Balboa with the two power plants; four 44,000-2,200-volt substations, stepping down at Cristobal and Balboa, and up or down at Gatun and Miraflores, depending on which of the two plants is supplying power; thirty-six 2200-240 volt transmission stations for power, traction and light at Gatun, Pedro Miguel and Miraflores locks; three 2200-220-110 volt transformer stations for the control boards at the locks; and stations at Cristobal and Balboa for the coal handling plants, machine shops and drydocks.

The Gatun Hydroelectric Station has a capacity of 6,000 kilowatts; and provision has been made to increase this to an ultimate capacity of 12,000 kilowatts, should this amount of power be required later for the operation of the Panama Railroad. The gross head available from Lake Gatun to mean tide level of the Pacific Ocean varies from a maximum of 91 feet in the extreme flood times to a minimum of 79 feet, to which level the lake may possibly drop toward the close of the dry season. The plant is designed consequently to develop the full water output when operating under an effective head of 75 feet.

The three 2,000 kilowatt main generating units in the Gatun hydroelectric station are each driven by a special 50-inch, vertical, single runner, Francis turbine manufactured by The Pelton Water Wheel Company. Each turbine has a maximum capacity of 3,600 horsepower when operating under an effective head of 75 feet and at a normal turning speed of 250 revolutions per minute. The turbines are located at such a height that the center of the runners is 20 feet above the tail water level. The turbines are of the spiral case type and are fitted with heavy cast iron distance rings which carry the generators.

The generators, under official tests, showed an efficiency of 95.1 percent at 2,000 kilowatt, 0.8 power factor.

The complete hydraulic equipment for this installation was designed and built by The Pelton Water Wheel Company; and all the electrical apparatus was designed and built by the General Electric Company, Schenectady, N. Y. The shipping weight of the material furnished by The Pelton Water Wheel Company, including the auxiliary electrical apparatus purchased by them from the General Electric Company, was approximately one thousand tons.

BUSCH-SULZER DIESEL ENGINES FOR UNITED STATES SUBMARINES.—The Busch-Sulzer Bros.-Diesel Engine Company, St. Louis, Mo., recently closed a contract with the Lake Torpedo Boat Company for six 600 brake horsepower reversible two-cycle marine Diesel engines for installation on three twin-screw submarine torpedo boats now building for the United States navy. Each engine will be provided with two separate scavenging pumps, arranged in line with the working cylinders, and also with two three-stage injection air pumps, all operated from the crankshaft.

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The Passing of the Clipper Stem

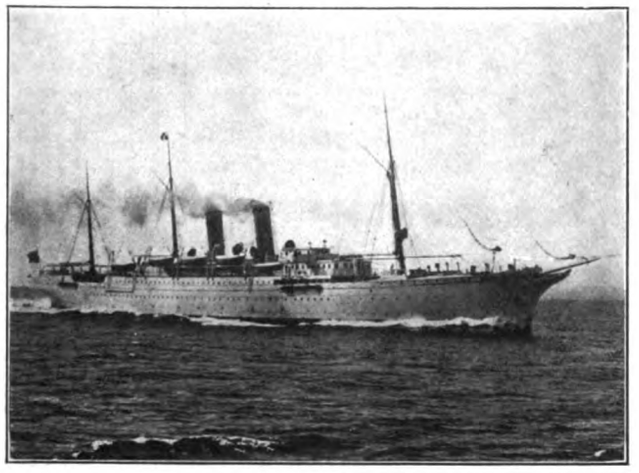
BY DAVID A. WASSON

A short time ago the American steamer *Jacob Luckenbach,* on her way down Chesapeake Bay, ran into the German steamer *Sigmaringen,* up-bound. It was a crash such as has sent many staunch ships to the bottom, yet it only slashed a hole in the German's side five frames wide, and left the *Luckenbach's* bowsprit and part of her stem in the foreigner's vitals. The *Luckenbach* has a clipper stem; and this feature, it is believed, saved the *Sigmaringen* from becoming a sunken hulk at the bottom of the bay.

Incidentally this unique Yankee tramp is a cosmopolite of the deepest dye. She was built at Sunderland, in 1881, was originally named *Hermann* and flew the Belgian flag. Next she went into Norwegian ownership and was renamed the *Hero.* Wrecked on the Atlantic coast a dozen years ago she was salved, placed under the American flag and christened *Success,* only to change owners and her name again a few years later.

To-day steamers with long, gracefully projecting prows like the *Luckenbach's* are rare sights afloat in any sea. All the modern liners have severely plain perpendicular stems. The newest of steam or gas-propelled pleasure craft follow suit. Even sailing yachts are nearly all designed nowadays with the so-called "spoon bow," the reverse of the clipper stem in profile. The picturesque old overhanging bow, with its ornate figurehead, seldom is seen but on dwindling windjammers of the old school and superannuated yachts.

Nevertheless the clipper stem had distinct advantages. Various authorities have recently expressed surprise at its discard by naval designers. In the press a prominent English architect not long ago deplored its passing. He declared that

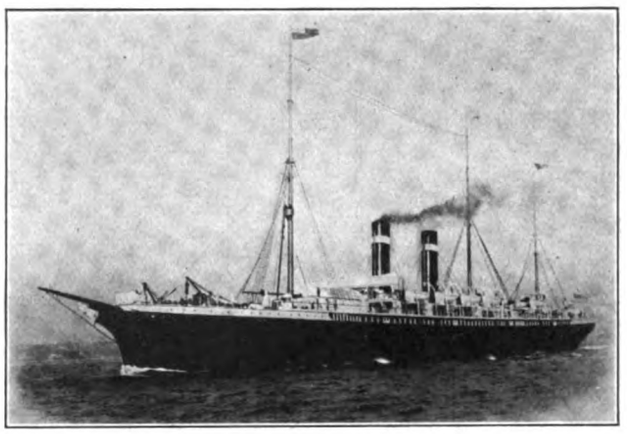


Canadian Pacific Steamship *Empress of Japan*

the steamship interests which are trying hard just now to meet the popular clamor for greater safety at sea might easily take a long step in the right direction by the simple restoration of the old-time clipper stem. To the argument that future oversea travel will know no collisions nor encounters with deadly icebergs is made the indisputable rejoinder that we live in the present. Yet in the world-wide agitation for the unsinkable ship the merits of the clipper stem seem to have been generally overlooked.

As proved by the *Luckenbach* collision just mentioned, the forward overhang of the clipper stem acts as a shock-absorber; inflicts its heaviest damage far above the waterline, and so lessens the risk of colliding steamers damaging each other fatally. Moreover, the topsides of clipper stem steamers flare or expand laterally forward, obviously giving added buoyancy. And certainly, if beauty ever again becomes a consideration in the construction of ocean greyhounds, all will wear the long, sweeping bow and dazzling figurehead now so nearly unknown.

Not a few ships besides the *Luckenbach* and *Sigmaringen* have owed their existence to clipper stems. The steamship *Pereire,* of the French line, bound from Havre to New York with several hundred passengers aboard away back in 1879, rammed an iceberg off the Grand Banks, not far from where the *Titanic* sank. The impact crumpled her bowsprit, figure-



American Line Steamship *New York*

head and clipper stem into a twisted mass of scrap iron, but they took the brunt of the blow. She reached port in a desperately crippled condition, but thankful to be there at all.

The *Percire* is still afloat and active, and one of the oldest iron craft in commission, having been built at Glasgow in 1864. She is now a full-rigged four-masted ship, the *Lancing,* hailing from Christiania, Norway.

The four-mast, three-funneled British steamship *City of Rome,* the fastest, largest and most beautiful liner of her day, also ran into an iceberg off Newfoundland on one of her early passages, and there is none to say that her overhanging bow did not save her.

Unfortunately the *City of Rome* is no more, for some ten years ago she was broken up for junk. Built in 1881 for the crack Inman Line, this splendid ship repeatedly broke speed records in her palmy days. Eclipsed by newer and larger ships, she was sold to the more leisurely Anchor Line. While under this ownership she was requisitioned as a transport to carry home in September, 1898, the Spanish prisoners of war from their detention camp at Portsmouth, N. H. In 1901 she took another step downward in the nautical social scale when she was sold to Italian account. Shortly thereafter the shipbreakers got her.

On the Pacific the Canadian Pacific Railway's white-painted beauties, *Empress of Japan* and *Empress of India,* plying between Vancouver and the Orient, and a few old foreign-built United States army transports acquired during the Spanish war, keep the clipper stem from extinction among steamers. The *Empress of China,* a duplicate of the other sovereigns, was wrecked two years since.

At the present time just three transatlantic steamships with clipper stems are known to the port of New York. All are foreign-built and, as ships go, are well along in years. The *New York* and *Philadelphia,* of the American Line, run steadily and without mishap between England and the metropolis. The British steamer *Oceana* has been out of commission for some time at New York. She was lately sold by the defunct Bermuda-Atlantic Line to the Morse Dry Dock Company of that city. So far as known, not an ocean-going

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merchant steamer with a clipper stem has been built since she was launched at Dumbarton, Scotland, in 1891.

Some years since, when the *Oceana* was owned by the Hamburg-American Line and flying German colors, the writer was aboard her in a winter southwesterly gale in the North Atlantic. One of her officers remarked that the 9,145-ton *Lusitania* couldn't have gone through it without shipping more water than was scooped aboard by the *Oceana*, 4,278 tons. Which alone many travelers will consider sufficient proof of the need for more clipper stems.

Side-Wheel Steamer Hanover

The Harlan & Hollingsworth Corporation, of Wilmington, Delaware, have just completed the light draft side-wheel steamer *Hanover*, for the Louisiana Steamboat & Ferry Company, New Orleans, Louisiana. This vessel is intended for service on Lake Pontchartrain, running between Milneberg and Mandeville, which are situated on opposite sides of the lake. For eight months in the year the vessel will be used for commutation service in connection with the railways, and during the winter season it will be used along the Mississippi River for afternoon and evening excursions.

The principal dimensions are as follows:

Length over all	188 feet
Length beteen perpendiculars	180 feet
Beam, molded	32 feet
Beam, over guards	54 feet
Depth, molded	8 feet 6 inches
Depth at lowest point of sheer	8 feet 6 inches
Depth at center	9 feet
Load draft	5 feet
Load displacement	480 tons
Speed	designed 14 miles per hour

Paddle Wheels

Type	Feathering
Number of buckets	9
Diameter over buckets	18 feet 5 inches
Length of buckets	7 feet 6 inches
Width of buckets	3 feet

Engines

Number	2
Type	Single-cylinder inclined
Cylinder diameter	25 inches
Stroke	7 feet
Indicated horsepower	designed—about 600
Valves	Corliss type
Condenser	Surface type
Cooling surface	About 1,380 square feet

Boilers

Number	2
Type	Cylindrical return fire tube
Pressure	90 pounds per square inch
Length	10 feet 9 inches
Diameter	10 feet 3 inches
Furnaces	
Number	2
Diameter	4 feet 2 inches
Grate area	85.2 square feet
Heating surface	2,592 square feet
Draft	Natural

Due to the limited depth of water in the lake, the vessel has been designed to carry 1,000 passengers, fuel, and stores on a 5-foot draft.

Hull Construction

The hull is of steel to the main deck, with the usual wood superstructure above. The keel is 18 pounds amidships, reduced to 15 pounds at ends, the bottom, bilge, and side plating is 11 pounds to 9 pounds at the ends, the shear strake is 15 pounds, reduced to 13 pounds at the ends. The frames are 5 inches by 3 inches by 8.2 pounds, angles with channel floors spaced 24 inches in the machinery space; forward and aft of the machinery space the frames are 4-inch by 3-inch angles, with 10-pound floors flanged on top to form reverse bars. The deck beams are 5 inches by 7 pounds structural channels on every frame with 10-pound knee brackets. The web frames, of which there are seven, are 10-inch channels extending from keel to deck with larged flanged brackets connecting them to the beams. There are two webs in the forward hold, one in the boiler space, three in way of the shaft, one in the engine space, and one in the after hold. There are three lines of keelsons in the hold on each side of the center, composed of 10-inch channels notched out to fit over the frames, and having 2½-inch by 2½-inch backing bars connected to the standing flange of the frame and the keelson. These keelsons are run from the stem to the stern, and are fitted intercostally between the bulkheads and webs.

There are five watertight bulkheads of 8-pound plate, with single 3-inch by 3-inch bounding bars stiffened by 4-inch by 6¼-pound channels spaced 30 inches vertically and 4 feet horizontally. The deck is fitted with tie-plates 12 inches wide by 10 pounds thick, the stringer is 30 inches wide by 12 pounds, reduced to 8 pounds at the ends. The overhang of the main deck is supported by angle beams 4 inches by 3 inches by 6 pounds, spaced about 3 feet, having 3-inch by 2¾-inch by 6-pound Z-bar braces connected to the sheell by 10-pound brackets. The guard stringer and face plate are formed of 8-inch by 11¼-pound channels. The engine and boiler casings above the main deck are of light steel, stiffened by angle bars with the straps forming panels. The wheel battery is of similar construction.

Owing to the requirements of the trade special attention has been given to the stanchions, it being necessary to carry automobiles on the main deck in the freight space, and instead of the usual number of small stanchions, large steel I-beam girders have been fitted under the saloon deck, supported by H-bar stanchions spaced about 20 feet apart. These stanchions have been arranged to extend from the keel to the underside of the hurricane deck in one piece.

The main deck is planked with Oregon pine, having oak planksheer, the outside of the guard is fitted with a yellow pine fender and wearing piece. The supports for the saloon and hurricane deck are composed of 4-inch I-beams carried in one piece from the main deck to the hurricane deck, connected to the stringer plate by brackets. In the way of alternate stanchions on the saloon and hurricane decks are fitted steel beams of 5-inch by 6-pound channels connected to the stanchions by means of 10-pound brackets.

The saloon deck is planked with tongued and grooved Oregon pine outside of the house, and tongued and grooved maple inside, the outside planking being covered with canvas. The hurricane deck is planked with tongued and grooved redwood, covered with canvas throughout.

General Arrangement

Quarters for the chief engineer, engineers, and mates are on the starboard side forward of the wheel battery; the barroom, and colored toilets are on the port side forward of the wheel battery; the firemen and crew are berthed on the lower deck forward, and the waiters and cooks on the lower deck aft. These quarters are fitted with metal berths and lockers.

The galley is fitted at the after end of the main deck, and is enclosed with a steel bulkhead, which is a continuation of the main deck house. The floor of the galley is covered with pressed Philadelphia brick, and the bulkhead at the forward end of the galley, where it connects with the main house, is composed of "V" grooved galvanized steel. Immediately for-

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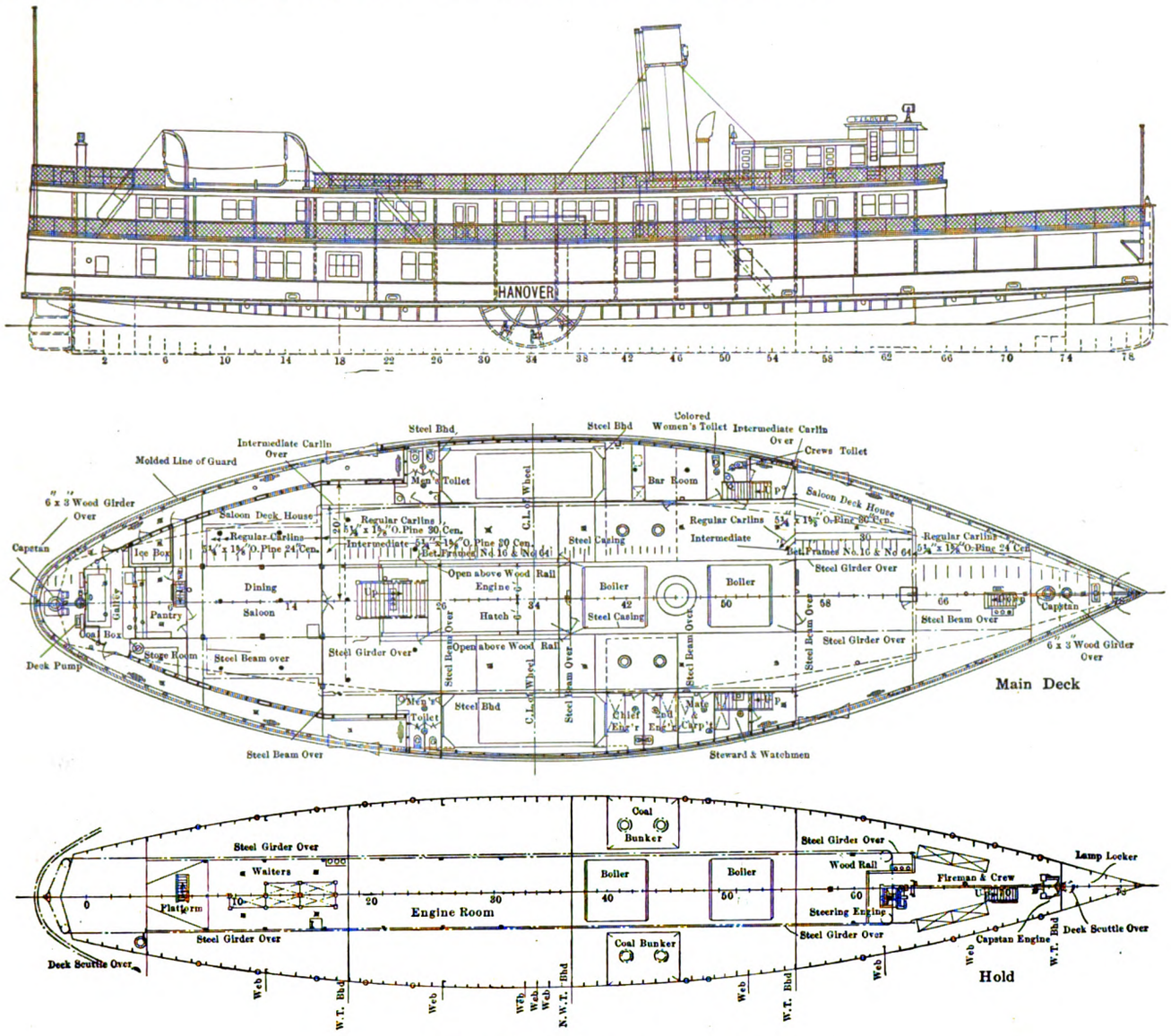
ward of the galley is a large pantry with an ice box on one side and a large dry storeroom on the other.

The dining room is at the after end of this deck space, having seating accommodations for fifty people. It is attractively paneled in oak wainscoting and composite board panels above, painted white. The entrance hall to the dining room, or lobby, is paneled the same as the dining saloon, the bulkhead between the dining saloon being arranged with oak-paneled wainscoting and glass panels above. The men's toilets are arranged one on each side of the entrance next to the end of the wheel battery.

Forward of these accommodations the entire house on the saloon deck is open, having oak seats on the sides. The deck, as mentioned before, is of maple. This space is intended for a dance saloon, and has been arranged accordingly. The stanchions supporting the hurricane deck have been spaced about 20 feet apart with heavy I-beam girders spanning these stanchions, supporting the deck.

The hurricane deck is entirely open and has very little obstruction on it. The pilot house, captain and officers' quarters are fitted in the house at the forward end of the stack, the pilot house, captain and directors' rooms being staved with "V" jointed oak. A departure from the usual type of these vessels is the fitting of a complete bathroom and toilet in this house for the captain's use.

The boat is equipped with lifeboats and life rafts to comply with the latest rules of the United States Supervising Inspectors. The deck auxiliaries include a steam steering gear of the Hyde make, with a 5-inch by 5-inch engine, a vertical steam capstan for handling the stockless anchor, and a 5-inch by 6-inch double engine dock capstan at the after end of the main deck abaft the house.



Profile and Deck Plans of the *Hanover*

Special attention has been given to the lighting of this boat, the wiring in the crew's quarters and cargo space being in conduits with the usual fixtures. The lights in the lobby and dining saloon are of 100-watt tungsten lamps and Pyro shades, fitted in safety holders in the ceiling. The saloon deck cabin or dance hall has been lighted with the same type of fixtures and shades, having 40-watt lamps. A searchlight of the Carlisle & Finch make has been installed on the pilot house, and also a running light indicator. Every effort has been made to bring this boat up to the latest requirements, not only of the inspection service, but to meet the requirements of the trade.

The machinery will consist of two independent inclined single-cylinder engines, each driving a paddle wheel. The cylin-

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ders are 25 inches diameter by 7-foot stroke, and exhaust into an independent circular surface condenser. The air and circulating pumps are independent, the former being of the vertical twin beam, and the latter of the centrifugal type, driven by a single-cylinder engine.

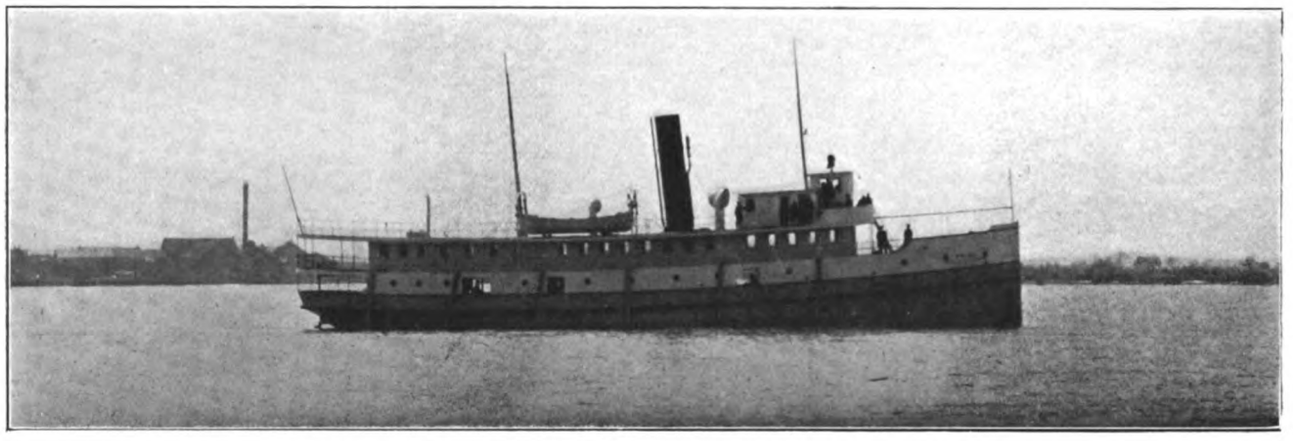
The wheels are of the feathering type, 18 feet 5 inches diameter over the buckets, each with nine buckets of white oak.

There are two cylindrical return fire tube boilers 10 feet 3 inches diameter by 10 feet 9 inches long, each fitted with two furnaces, the working steam pressure being 90 pounds per square inch. The boilers will be worked under natural draft. A circular superheater with corrugated flue is placed between the smokeboxes and the base of the stack, connected by copper pipes to the steam space of each boiler.

The installation of auxiliary machinery includes independent feed pumps, fire and donkey pumps, sanitary pumps for toilets, and a fresh water pump for the kitchen, etc.; the multicoil feed water heater between the feed pumps and boilers, and a feed filter tank between the hotwell and feed pumps.

Freight and Passenger Steamer Pelee

The Collingwood Shipbuilding Company, Collingwood, Ont., has just completed a handsomely modeled single screw package freight and passenger steamer, named the *Pelee*, for the Windsor and Pelee Island Steamship Company, of Amherstberg, to trade on Lake Erie, between Pelee Island and the mainland. The principal dimensions are: Length 146 feet, beam 24 feet, depth 18 feet 3 inches to promenade deck.



Package Freight and Passenger Steamer *Pelee*, Built on the Great Lakes

The number of passengers for which accommodations are provided is 500.

The vessel is built of steel to the highest class in the Great Lakes Register, and has a complete steel main deck all fore and aft for the stowage of package freight, with four large gangway doors and two lumber doors at the sides. There is accommodation at the after end of this deck for the engineers, steward and purser, with lavatories and shower baths. The crew is berthed on a lower deck at the forward end of the vessel.

Above the main deck, extending the full length of the vessel, is a promenade deck, with a large deckhouse about 100 feet in length. The forward part of the deckhouse forms a commodious saloon with ample seating accommodation. The after end contains a large dining saloon, with galley and pantry adjoining.

A boat deck over the saloon deckhouse extends to the stern, forming a shelter for passengers on the promenade deck, and carrying lifeboats fully equipped, conforming to the Canadian government inspection laws. At the forward end of the boat deck is a house for the accommodation of the captain and mate, two spare staterooms, and the wheelhouse.

The vessel is driven by a triple-expansion jet-condensing engine, with cylinders 12½ inches, 21 inches and 34 inches diameter, with a common stroke of 21 inches, developing 500 indicated horsepower. Steam is supplied by a Scotch boiler 12 feet 6 inches diameter by 11 feet long. A small donkey boiler is installed for use in port when the main boiler is being cleaned.

The trials of the vessel were successfully carried out April 15, when a mean speed of 14.6 miles per hour was maintained.

An Oil-Burning Tug

One of the most completely equipped, powerful steel harbor tugs that has been put in service in New York harbor will be the new vessel just completed from designs by Messrs. Cox & Stevens, of New York City, for the Undercliff Terminal & Warehouse Company.

The principal dimensions are:

Length over all	110 feet
Length on waterline	102 feet
Molded beam	26 feet 6 inches
Molded depth	13 feet 6 inches

The contract for the construction of the vessel was awarded to J. H. Dialogue & Sons Company, of Camden, and the work was completed by the Staten Island Shipbuilding Company.

In preparing the plans and specifications the architects had instructions to investigate all the existing tugs of similar size and power, the result being that they determined upon the dimensions given above, and for propulsion a compound engine, with clyinders 19 and 42 inches diameter and 30 inches stroke. Steam is supplied by a Scotch boiler, 16 feet in diameter and 11 feet in length, having four furnaces, in which oil fuel is used for firing.

The scantlings of the hull are unusually heavy; the deckhouse is of steel; and while of ample size there is sufficient clear deck at both ends of the tug for the necessary handling of the lines. The quarters for the captain are in the pilothouse, and for the engineer in the deck-house on the starboard side, handy to the engine room.

In the design of engine details unusually large bearing surfaces have been provided, and the lubrication system has been carefully worked out. The auxiliaries include a condenser, circulating pump, air pump, feed pump, donkey pump, fire pump and a feed-water heater. There is also a complete installation for electric lighting and a Williamson steam steering engine for handling the steering gear.

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Questions and Answers for Marine Engineers

Inquiries of General Interest from Readers
Will be Answered in This Department

CONDUCTED BY H. A. EVERETT*

Q.—Please explain the best way of working out the pitch of a propeller by measurements taken from the propeller on board ship. N. P.

A.—The accurate determination of the pitch of a propeller is usually not easy, as except for propellers with planed blade faces it varies at different points over the blade. The customary way of accurately measuring pitch is to strike on the

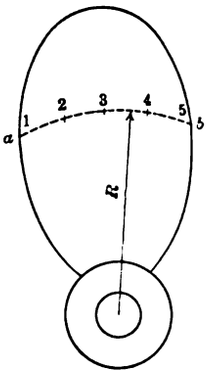

Fig. 1

face of the blade an arc of a circle, *a b* (Fig. 1), of any radius concentric with the axis of the propeller. Divide this into a number of equal intervals, as 1, 2, 3, 4, 5. Measure the developed distances of the arc on the surface of the blade and

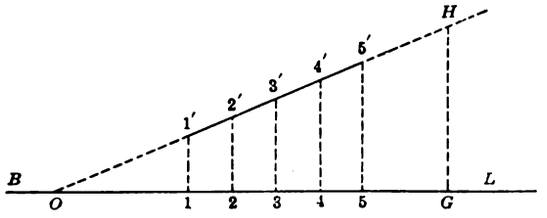

Fig. 2

lay them off on a base line *B L*, Fig. 2. Measure the distance from each point on the propeller to a plane perpendicular to the axis of the propeller, and lay these off (1-1′, 2-2′, etc.) as ordinates at 1, 2, 3, 4, 5 on the base line. Draw a line through the points 1′, 2′, etc., and produce it till it cuts the base line at

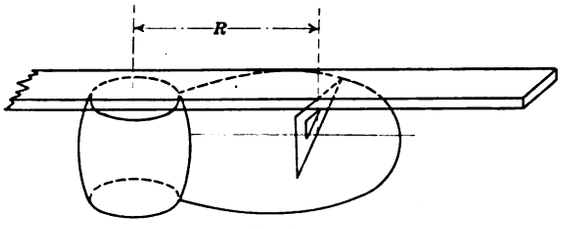

Fig. 3

O. From *O* lay off *OG* equal to the circumference of the circle of radius *R* (6.28 *R*), and at *G* erect a perpendicular till it cuts *O*-5′, extended, at *H*. *GH* is the pitch. If the pitch is uniform axially, 1′-5′ will be a straight line; if not it will be curved, in which case tangents should be drawn to each end and produced to the base line, the pitches determined for both and averaged. A careful determination of pitch requires the above procedure to be repeated for each blade and several radii on each blade.

A quick and easy method, but approximate, is to determine the radius at which the acting face of the blade (rear face) is at 45 degrees with the face of the hub. To do this, first draw a center line on the face of the blade and clamp a straight-faced plank across the rear face of the hub. Place a 45-degree triangle between the plank and blade, and move it out (always at right angles to the center line of the blade) until it fits (Fig 3). The radius from the center of the hub to this point, multiplied by 2π, or 6.28, will give the pitch approximately. This method holds only for blades of constant pitch and a pitch ratio (P/D) not less than 0.8.

Q.—Why is it that the inside and outside butt strapps on a Scotch marine boiler are made of the same width, while on a horizontal tubular boiler the inside strap is made wider than the outside strap?
L. M. N.

A.—The majority of horizontal tubular boilers in use ashore are externally-fired boilers. In boilers of this type it is necessary to keep the thickness of the shell and butt strap to a

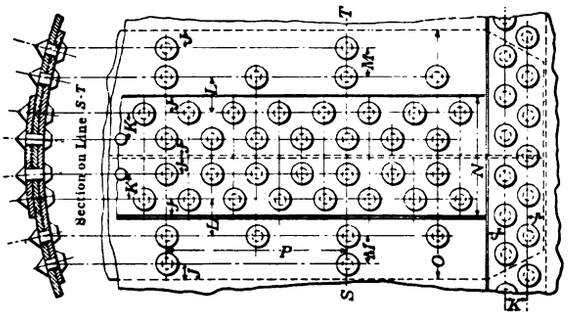

Fig. 4

minimum, to give efficiency of operation and prevent the shell burning away. With thin external butt straps and wide rivet spacing the calking is unsatisfactory, so the outer part of the strap is cut away. See Fig. 4. A quadruple riveted joint of this type will give efficiencies as high as 94 percent for boilers

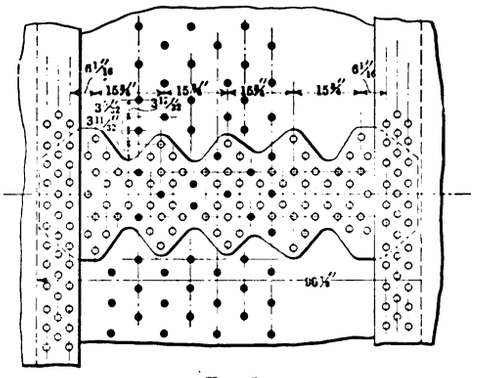

Fig. 5

whose shell does not exceed 5/8 inch, and still have a good calking pitch in the outside strap. In an internally-fired boiler of the Scotch type the shell is usually much thicker, and with the thick straps a gain in efficiency is possible by extending the outer butt strap to equal the width of the inner one without the attendant defect of a rivet pitch in the outer rows too great for satisfactory calking.

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The custom has been to use treble riveted butts with equal straps, and though the treble riveting is less efficient than quadruple it gives a spacing of the outer rivets close enough for good calking (10½ inches in a boiler whose shell is 1½ inches thick).

Occasionally quadruple riveting has been used, as in some of the large German liners, in which case the pitch of the outer rivets is too great for good calking and the straps are scalloped (see Fig. 5).

Q.—What factor is used on a crosshead guide and what effect has the length of the connecting rod on the wearing surface? M. M.

The size of the crosshead guide is determined by the dimensions of the crosshead slipper and the stroke. The crosshead slipper is usually designed so as to have a bearing pressure of about 50 to 80 pounds per square inch net area (Seaton* suggests

$$\frac{1{,}000}{\sqrt{\text{piston speed}}} + .5 = \text{allowable bearing pressure.}$$

) It is customary to calculate the total pressure as follows: Assume the pistons at one-half stroke and as having the maximum

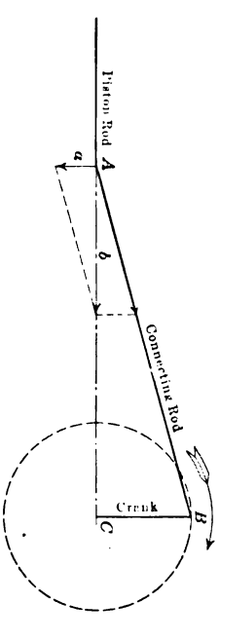

Fig. 6

effective pressure acting upon them. Let us assume that for a given case the low-pressure cylinder is 72 inches diameter (area = 4.071 square inches), and the difference in pressure is 20 pounds; then the force acting to drive the piston is 20 × 4.071 = 81,420 pounds. This force must now be resolved into two components—one along the connecting rod representing the thrust of the rod, and the other perpendicular to the guides representing the maximum load on the crosshead, which occurs when the crank is at 90 degrees (see Fig. 6). From the similar triangles, thrust of piston (b) : load on crosshead (a) : : AC : BC, the right-hand side of this proportion is a function of the ratio of the length of connecting rod to crank, and so the proportion may be written:

$$\frac{\text{thrust of piston rod}}{\text{load on crosshead}} \begin{cases} = 4.90 \text{ for ratio } \dfrac{\text{connecting rod}}{\text{crank}} = 5 \\ = 4.39 \quad " \quad " \quad = 4\tfrac{1}{2} \\ = 3.88 \quad " \quad " \quad = 4 \end{cases}$$

The commonest ratio in mercantile work is 4½, so for the case in hand:

*Seaton & Roundthwaite's Pocketbook of Marine Engineering.

$$\text{Load on crosshead} = \frac{\text{thrust of piston rod}}{4.39} = \frac{81{,}420}{4.39} = 18{,}550$$

pounds. If we accept an allowable load per square inch of surface of 73 pounds, this would give a net area of 254 square inches. Increase this by 20 percent to allow for oil grooves, etc., and we have 293 square inches. The slipper usually has a length to breadth ratio of about 4/3, so 293 = length × 3/4 length.

Length = $\sqrt{391}$ = 19.8 inches, use 20 inches by 15 inches.

The length of the guide will be the stroke, plus the length of the slipper, minus the over-travel.

If we accept an allowable pressure per square inch the expression for area of the crossread can be simplified into

$$A = \frac{\text{thrust of piston rod}}{C}.$$

C for a ratio of $\dfrac{\text{connecting rod}}{\text{crank}}$ of 4½ has the following values:

Crosshead Bearing Pressure	C
50	176
60	211
70	246
80	281

Q.—Why is the feed-water heater usually placed higher than the feed pumps? F. P. N.

A.—The feed water heater, if on the suction side of the feed pump, should be placed higher than the pump in order that the pump will prime at all times and not become air or vapor bound. Feed heaters are of two general types—surface and jet. The former may be placed upon either the suction or delivery side of the feed pump; the latter always on the suction side. In either type the steam is condensed, and the feed water raised to a temperature but little lower than that corresponding to the pressure of the steam used for the heating. If the heater were placed on the suction side of the pump, and some distance below it, the lift of the pump would so reduce the pressure on the feed water that it would reboil in the suction line, and by its vapor cause the pump to become vapor bound. Surface heaters placed upon the delivery side of the feed pump may be either above or below.

INTERNATIONAL NUMBER OF THE "SHIPBUILDER."—The third annual International Number of the *Shipbuilder*, published by the Shipbuilder Press, Newcastle-on-Tyne, price 65 cents, has just been published. This takes the form of a resumé of all the papers devoted to shipbuilding and marine engineering which have been read during the past year before the scientific and technical institutions throughout the world. In all, the volume contains abstracts of seventy papers and upwards of 200 drawings and diagrams.

SUMMER MEETING OF THE INSTITUTION OF NAVAL ARCHITECTS.—At the summer meeting of the Institution of Naval Architects, to be held at Newcastle-on-Tyne, July 7, 8, 9 and 10, in conjunction with the Institution of Engineers and Shipbuilders in Scotland and the Northeast Coast Institution of Engineers and Shipbuilders, the following papers will be presented for discussion: Some Notes on Warships Designed and Constructed by Sir W. G. Armstrong, Whitworth & Company, Ltd., by J. R. Perrett; A Review of the Progress of the Marine Steam Engine During the Last Fifteen Years, by A. C. Ross; Charging of Two-Cycle Engines, by Professor B. Hopkinson, F. R. S.; A New Type of Internal-Combustion Engine, by H. F. Fullager; Influence of Varying Temperatures on the Strength and Other Properties of Admiralty Gunmetal, by Professors A. Campion and John G. Longbottom; The Strength of Welds by the Oxy-Acetylene Process, by Professor A. Campion and William C. Gray; Some Experiments on a Diesel Engine, by W. S. Burns.

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Letters from Practical Marine Engineers

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs

Water Levels and Gage Cocks

Not many engineers would continue to run their boat with the boiler carrying 140 pounds pressure without being able to see the water level in that boiler. The chief engineer of a towing vessel had such an experience when the water glass broke and it was found that there were no extra ones and that the gage cocks were corroded beyond usefulness.

When everything was running normally this boiler had a habit of lifting the water and the feed pump, therefore, had to be carefully regulated. This was an advantage now and the valve that regulated the water to the pump was set for a little extra feed. The top valve on the water glass was then opened slightly and the spray from it carefully watched. If the spray appeared too wet the feed was checked and if too dry the feed was increased. Of course, since there was no superheater, a careful watch was kept to see that no water reached the engine.

As soon as possible an attempt was made to mend the water-glass temporarily by inserting the broken ends into a block of wood and thus form a fairly good union, but this proved vain, as it leaked badly. Finally the assistant engineer got three short ⅛-inch nipples and a couple of tees and screwed them together, making an overall length of about 13 or 14 inches. This took the place of the water-glass nicely and by inserting two pet cocks into the tees the arrangement was made to perform the function of the glass. The next time the boiler was washed the corroded gage-cocks were taken off and replaced, and since then there has always been a plentiful supply of water glasses aboard.

In a similar case a new man had just come on watch and had failed to locate the stops. The gage-glass broke and it took considerable nerve to go through that water and steam and grope around, and find the stops, then shut them off. Now, since that incident, on going aboard a strange boat, the first thing that man does is to locate the gage-stops.

A boiler on another vessel was equipped with a patent shut-off valve on the water line. The vessel came to dock and the engineer pumped the boiler to a level 1 inch from the top of the glass. The boat docked for about an hour and shortly after starting out the water was at the same level. Upon investigation the engineer found that the glass had broken at the top nut and of course the patent stop valves had closed, so that no noise occurred. The water was at the bottom of the glass according to the gage cocks when the break was found, and that was only 4 inches above the fusible plug, also the boiler only had a 6 inch safe working level. Gag-cocks are valuable, should be taken care of and used frequently to check the gage-glass. C.

Albany, N. Y.

Old-Time Methods

While on shore leave at Providence, the writer visited Mystic, Conn., and got into conversation with a very nice old gentleman, who had been a machinist and a fitter. In telling me about Mystic, he showed me a site where the first United States ironclad man-of-war, called the *Galena,* was built. He went on to tell of a Scotchman who turned up one day just when they started to plate the vessel. They put him to work chipping the plates. This Scotchman chipped off a strip some 22 feet long, starting from about 1/16 of an inch and ending up at about ⅜ of an inch, all in one piece. It was hung up in the office of the company as a remarkable piece of work. Then the old gentleman told me about a condenser that interested me.

He said that the heads of the condensers were made in those days of two cast plates which were riveted into the condenser shell and the holes in these plates were just through holes, not screwed as they now make them. The tubes projected through the plate and over each tube a rubber washer was forced and then a second, cast brass plate, drilled to match, was put over the tubes with studs and nuts drawn up so as to make a tight joint at each tube.

The apprentice boys punched out the rubber washers with what he called "wad-cutters" and the holes were cut smaller than the outside of the condenser tubes, so it was a hard job to force the rubber washers over the tubes. This Scotch lad looked at the boys putting on the washers, then going to the "Boss" told him he could show him a trick that would help matters. He seemed to be very handy with any tools and he went into the wood turning shop, took some old hickory handles of sledges that had been thrown away, and turned up half a dozen tapered pieces one end of which just fitted into the condenser tubes, while the other end was of the same diameter as the outside of the tubes but was tapered. He brought these back to where they were fitting up the condenser, stuck one of these pieces into a condenser tube, took a rubber washer, dipped it in water, pushed it over the wooden plug and down over the tube in about half a second. The boys had been working all the morning, trying to get the washers over the tubes, but this little trick made the job easy. BREAKDOWN JOHNNY.

Cylinder Lubrication

The lubrication of cylinders of marine engines, using a surface condenser returning the water of condensation to boilers, is an important problem to be solved by the engineer. The amount of oil used in the cylinder should, of course, be the minimum required under the conditions of operation and must be ascertained by experience. Many engineers claim that oiling of the cylinder is not required at all, saying that the necessary lubrication is obtained, especially where a piston valve is used, by swabbing the rods at regular intervals. Two iron surfaces constantly rubbing each other with only the condensation of steam to depend on for lubrication, may, in some cases, work well, but just how much rubbing they will stand without evident signs of wear is hard to say and depends greatly on the alinement of the piston, rod and slides.

An engineer in charge of a large compound engine informed the writer that no oil was fed to the cylinder but that the rods were swabbed every hour. This engine had been in operation for a period of six years and during that time the cylinders had been bored twice.

Another marine engineer of long and varied experience claims that the cylinders must have lubrication of some description besides water or steam, neither of which stops wear, and when there is no lubricant there will surely be wear. This man has found that old rope, condemned from the deck, is the best and most economical material for collecting the oil from the water of condensation and has used it in his filter box for years.

Of course the oil is eliminated from the engines to save the boilers because it is cheaper to bore cylinders and occasionally fit a liner than to buy new boilers. Such conditions are common not only in practice but in design; what is of

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advantage to one part may be a disadvantage to some other part of the system. A compromise then is the only logical solution for economy and efficiency.

Graphite with kerosene (paraffin), as a lubricant, has often been recommended and is used to a great extent with good results in many cases. The too frequent use of graphite tends to fill the space back of the sectional ring in the low-pressure cylinder, but no harm will result if the accumulation is cleaned out at regular intervals when rings are removed for examination. Graphite fills the pores in the liner, and if used when the engine is set up and worked into the liner is sufficient lubrication in some cases. A beam engine has been operated many years with a cylinder lubrication of one-half pint of water mixed with a teaspoonful of graphite for each seventy miles and good results are obtained. No oil is fed to this cylinder except that carried in by hourly swabbing.

Piston valves should be adjusted so that they may be slightly loose on the rod in order to find themselves free to travel true in their chambers. Many piston valves, adjusted with great care, have been found stuck to the rods with rust when removed for examination. This is probably due to lack of oil or lubricant to keep them free.

Ideas from others who have had experience or made a study of lubrication, especially with cylinders, would help greatly, as the problem is one with a large variety of solutions. Each individual case requires much thought and a complete understanding of conditions for successful operation.

ISAAC N. CORY.

Friction

In the May issue of this paper, under the heading of "Friction," your contributor "Ison" made several statements about the causes of friction with which I am unable to agree. I believe that the other side of this question should also be set forth in order that any of your readers who may feel so inclined may get both views without consulting some scientific work.

According to the eleventh edition of the Encyclopædia Britannica," one of the latest and best authorities on such subjects, friction "is due to the roughness of the surfaces; the minute projections upon each enter more or less into the minute depressions on the other, and when motion occurs this roughness must be either worn off, or the projections continually lifted out of the hollows into which they have fallen, or both, the resistance to motion being in either case quite perceptible and measurable." This is the generally accepted theory regarding the cause of friction.

Your correspondent quotes one of the laws of friction; that is, that "Friction is independent of the area of the surfaces in contact for any given normal pressure, etc."; and then states that "if friction were due to the interlocking of the projections, it will be seen that friction will become dependent upon the area of the bearing surfaces in contact, which is in direct opposition to the second law." It does not seem to me that this law and the theory as above given are in opposition; in fact, it seems to me that they are in exact accord. To illustrate this agreement, let us consider that the surfaces in contact are in such condition that each minute elevation of the one exactly fits into each minute depression of the other. Then, in order to make one move upon the other, neglecting possible abrasion, it will be necessary to apply sufficient force to make each minute elevation slide uphill—out of the depression in which it rests and up on to the adjacent elevation. It then slides down into the next depression, and after this repeats the whole operation as often as may be necessary to move the required distance. The operation of sliding uphill is directly dependent upon the intensity of normal pressure, which may be illustrated on a larger scale by the fact that it will take just one-half the work to move a frictionless vehicle weighing 1 ton up an incline as will be required to move a similar vehicle weighing 2 tons up the same incline. If we assume that it takes a pull of x pounds to overcome the friction caused by a load of P pounds on a bearing surface of 1 square inch, we easily see that by increasing the bearing surface to 2 square inches the intensity of normal pressure on each square inch of bearing surface is reduced to $P/2$ pounds, and, therefore, that the pull required to overcome the friction of that particular square inch is $x/2$ pounds. But we now have a bearing surface of 2 square inches, each of which requires a pull of $x/2$ pounds to overcome the friction of its surface, so that the total pull required will be two times $x/2$, or x pounds, which is the same as in the first case. The principle of this solution may be extended so as to cover almost any similar case, and it shows conclusively that the law of friction above quoted and modern theory are in strict accord with each other.

Your correspondent further states that "with interlocking projections, when one surface slides over another, we would get abrasion of the surfaces taking place, and the laws of friction would not hold good." This is exactly what happens in practice: When one surface slides over another we get abrasion, and if the surfaces are of the proper character they get smoother and smoother as the abrasion goes on. As a proof of this, just consider the condition of a smooth-running bearing immediately after adjusting and again after several weeks of wear. The laws of friction apply here, but the coefficient of friction must be modified as the characters of the surfaces change. The coefficient of friction that is applicable immediately after adjustment will be too large when the bearing is in perfect running condition.

Quoting again from the article in question, we find that "if two bodies were perfectly smooth there would still be a certain amount of resistance to sliding, hence it would seem that friction is really due to the molecular cohesion of the particles of each surface." In considering this statement we must ask whether or not it is physically possible to get two bodies with perfectly smooth surfaces. The answer must be that it is not possible, because one can hardly conceive of any substance in which the molecules are so perfectly formed and arranged as to allow a perfectly smooth surface, just as it is impossible to imagine any case in which it is possible to form a perfectly smooth surface on a barrel of apples or on a dish of beans. As the constituent parts grow smaller we approach absolute smoothness, until, when the parts become the size of molecules, we can go no farther. Needless to say, human means has never approached the limit of smoothness possible on account of the minute size of the molecule, so that all surfaces necessarily show friction when moved in contact with one another. The theory of molecular attraction is not necessary to account for the friction between seemingly smooth surfaces.

It should be remembered that the "laws" of friction are not laws in the strictest sense, but that they are little more than practical rules. They hold good, within certain limits, with sufficient accuracy for all practical purposes. They do not hold good at very high or very low speeds, or at very high pressures or very low pressures. They are affected by the length of time the surfaces have been in contact. It is well known that the so-called "friction of rest" exceeds the corresponding "friction of motion" for the same body under the same circumstances. None of these exceptions seems unreasonable when taken in connection with the theory that the friction is due to the roughness of the surfaces in contact.

That there is an attraction between different bodies is a well-established fact, but the friction due to the attraction existing between the masses of the moving parts is negligible, unless it might happen that the bodies were magnetized. This only increases the apparent normal pressure between the two bodies.

W. W. B.

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Marine Articles in the Engineering Press

Self-Docking Floating Dry-Docks.—The remarkable rise of the importance of floating dry-docks is commented upon. While formerly floating docks were thought suitable only for merchant vessels, they are now used most successfully for the largest battleships. In large sizes, built in the German navy up to 40,000 tons capacity, self-docking features are considered to be of the utmost importance. In turn are discussed the self-docking features of: The sectional dock with an internal width larger than the length of each section; two forms, each of three sections with sponsons; the type with two longitudinal girders and numerous small pontoons; several forms with floating side girders and internally-lifted or connected pontoons. Finally, some new constructions of three-section docks are said to contain a number of improvements for self-docking in only two operations, as well as for the possibility of riveting the sections together while partly afloat. 4 illustrations. 2,200 words.—*Schiffbau,* April 22.

Marine Oil Engines of the Dutch Navy. I.—The different requirements for the power plants of naval and merchant vessels seem to point to the desirability of the oil engine for naval vessels. Although large units still present serious obstacles, the smaller units are nowadays very serviceable as long as the fuel supply is reasonably assured. The oil engines as installed by the Dutch Navy are of the type manufactured by the M. A. N. Company, of Nuremberg. They are of the step-piston type, with the scavenging piston below the power piston, working two-cycle and single acting with six and four cylinders. The bedplates and crank cases are of bronze, securing for quick-running engines a weight of 46.2 pounds per horsepower and for slow-running engines a weight of 103.4 pounds per horsepower. Special mention is made of the very complete oil lubrication and oil piston cooling system used in these engines, and the details of the valves, valve shafts, cams and reversing gear are explained very fully. 19 illustrations, 3,600 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* April 4.

Marine Oil Engines of the Dutch Navy. II.—The machinery installations of submarine boats, small shallow-draft armored vessels, and of the boats for the East India service are described, together with some of their auxiliaries. In the armor-clads, the oil engines are too high to be placed entirely below the waterline, and are, therefore, protected by inclined armor. To guard against the total loss of compressed air, which would prevent starting the machinery, a very small auxiliary compressor and dynamo is fitted which can be started by hand. Abstracts of the trial data of several of the engines built at the works of the M. A. N. are given, as is also data covering the gradual reduction of starting pressure in a reservoir of fixed capacity by alternately reversing the engine from ahead to astern. A reservoir of about 250 gallons capacity could reverse a 600-horsepower engine about fifteen times, while one of 125 gallons could reverse about ten times. A peculiar feature discovered was that the weight of air used at each reversal gradually decreased, apparently due to the fact that each reversal needed about the same number of revolutions. All of the trials extended over several hours and one up to thirty-six hours, with an average fuel consumption normal of ½ pound of .858 specific gravity gas oil per horsepower hour. 13 illustrations. 3 tables. 1,870 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* April 11.

Warship Types of the Near Future.—Commenting editorially upon the speech of the First Lord of the Admiralty in introducing the naval estimates, it is pointed out that the superiority of the gun attack to the defense in naval construction may bring about a temporary check to the increase in dimensions of naval vessels, even if questions of deck accommodations or initial cost of units do not do so. It is suggested that the type of destroyer recently laid down is likely to develop into boats of rather smaller size, but of higher speed with much more powerful armament, to be led possibly by one or two flotilla leaders of greatest size, speed and gun power. It is also probable that the submarine will evolve into something like the light cruiser of the present day but with submersible qualities. The recent development of the seaplane and aeroplane for naval purposes might also tend to an all round increase of speed, though the ordinary attainable speed of ships is small compared with that of the aerial craft. 2,700 words.—*The Engineer,* April 3.

Torpedo Boat for the Spanish Navy.—The Sociedad Españalo de Construcción Naval was formed to undertake the carrying out of the programme as proposed for the construction of a new fleet for the Spanish Navy. The designs of torpedo boats for this fleet embody some unique features. In appearance they are like the general type of destroyer except for the fact that there is no raised deck forward, the deck line being practically straight. These boats have a length between perpendiculars of 164 feet, length over all 172 feet 5 inches, breadth extreme 17 feet 2 inches, mean draft 4 feet 10 inches and a displacement of 186 tons (metric). The propelling machinery is composed of the triple-series system of turbines, all of the Parsons type. There is a cruising and reverse turbine on the center shaft with the low-pressure turbine, the reverse being in the same casing as the low-pressure according to regular practice. The turbines are designed so that at full power the low-pressure on the center shaft develops 50 percent of the total power and the high and intermediate on the wing shafts each develop 25 percent. They are also arranged so that in case of accident to either wing shaft both can be cut off and steam admitted direct to the cruising turbine and thence to the low-pressure turbine. The two condensers are of the Normand type and have each a cooling surface of about 1,800 square feet. The center shaft is designed to turn at 1,100 revolutions per minute and the wing shafts at 1,500 revolutions per minute, giving, in a four hours' trial by the various boats with full load aboard, between 27½ and 28 knots. 1 illustration, 3 plates. 1,200 words.—*Engineering,* May 1.

Italian Scout Cruisers Marsala and Quarto.—A study of Italian warship design shows that the Italian naval authorities aim at very heavy offensive qualities, such as armament combined with the highest possible speed and the lightest possible hull. It is claimed that this idea has been carried too far with the new scouts *Marsala* and *Quarto* in that they have proved poor sea boats. The *Quarto* was laid down in Venice in November, 1909, launched in 1911 and completed for sea last year. She displaces 3,300 tons and has a length between perpendiculars of 417 feet, a beam of 42¼ feet and a mean draft of 13 feet. Propulsion is by Parsons turbines designed to develop 25,000 horsepower and it is reported that the vessel easily attained a speed of 28 knots. The *Quarto* is the third Italian ship to have Blechynden boilers installed. The armament is the same in both ships, consisting of six 4.7-inch and six 3-inch guns with two 18-inch torpedo tubes. The *Marsala* and *Nino Bixio* are somewhat larger ships, with a length between perpendiculars of 431 feet, a beam of 42½ feet, a mean draft of 13¼ feet and a displacement of 3,470 tons. Parsons turbines, designed to develop 22,500 horse-

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power, are installed and steam is furnished by Blechynden boilers. 4 illustrations. 1,200 words.—*The Marine Engineer and Naval Architect,* May.

The Dutch Pilgrim and Cargo-Carrying Steamer Riouw.—The steamer *Riouw,* recently completed by Messrs. Archibald McMillan & Son, Dumbarton, to the order of the Stoonvaart Maatschappij, Nederland, Amsterdam, for pilgrim transportation and general cargo trade in the Far East, is 450 feet long between perpendiculars with a molded breadth of 55 feet 8 inches; a molded depth to upper deck of 30 feet 3 inches; a deadweight carrying capacity of 10,400 tons, a gross tonnage of 7,545, and a net tonnage of 4,755. The hull is subdivided by seven watertight bulkheads and the cargo space is divided into four large holds. The arrangements for handling cargo are very complete, including 20 steam winches and 29 steel tubular derricks, one of which is suitable for loads up to 30 tons. Propulsion is by a triple-expansion engine having cylinders 28½, 47 and 82 inches diameter by 54 inches stroke, designed to develop 5,000 horsepower. The air and condensate water pumps for the main engine are of the Mirrlees-Le Blanc rotary horizontal marine type, driven by a small De Laval steam turbine. The extraction of the air from the condenser by means of the air pump is done by water taken from and discharged back to the sea. The condensate water extraction pump, which is of the centrifugal type of special design, draws the condensate water from the condenser and delivers it to the feed filters. There is an independent De Laval feed pump system, consisting of a single-stage centrifugal pump drawing from the feed water filter and discharging into the feed heater, and a multi-stage centrifugal pump drawing from the feed heater and discharging into the boilers. Steam is discharged by six single-ended Scotch boilers, 13 feet 9 inches diameter by 12 feet long, designed for a working pressure of 213 pounds per square inch and fitted with Howden's system of forced draft. The steam is superheated by means of smoke tube superheaters made by the Ottensener Eisenwerk, A. G., Hamburg, Altona. On trial the vessel obtained a mean speed of 14½ knots. In this article an unusual amount of space is devoted to a description of the riveting of the hull; the diameter and spacing of rivets being given throughout the ship. 3 illustrations. 2,200 words.—*The Shipbuilder,* May.

The Putilow Shipyard.—The Putilow Shipyard, in St. Petersburg, Russia, is owned by a concern which has had experience in ordnance manufacture and steel construction extending over more than one hundred years. Since 1907 shipbuilding has been carried on by this company in a special department, and in 1910 a working agreement was made with the German shipyard of Blohm & Voss, Hamburg, for modernizing the shipyard and developing its equipment. Special mention is made of the installation of cranes at the building ways by the German firm Deutscher Maschinenbau, A. G., Duisburg. Brief description is also given of the building ways, the various shops and their machinery. 28 illustrations. 4,800 words.—*Schiffbau,* May 27.

Marine Indirect Drives.—This article deals with the recent tendency in marine power plant installations to break the direct connection of the driving power from the propeller by the introduction of a separate agent of transmission. Aside from mention of Foettinger hydraulic transformer, considerable space is given to the gear transmitter now frequently used with very satisfactory results on English vessels. The high efficiency of 97 to 98 percent of this type of gear, together with the great reduction in weight, space and steam consumption of the turbine, is stated to bring this arrangement of propulsive machinery commercially and financially to the level of the ordinary reciprocating engines as usually installed in medium-sized merchant vessels. The second new method of indirect drive discussed is that involving electricity, the current being generated by one or two independent non-reversible turbines or internal combustion engines, and led to one of two motors on the propeller shaft, with the necessary provision for reversing. The vessel *Tynemount* is fully described, showing the arrangement for concentrating the power of either one or both main Diesel oil driving engines upon a single large reversible alternating current motor on the propeller shaft. The special advantages derived are given as the economic adaptability of power production to power requirements, the independence and security from complete breakdown by two main engines, simple reversibility of motor and non-reversibility of the engines and the possibility of control from the bridge. The *Jupiter,* of the United States Navy, is also described, attention being directed to the great saving of weight over the corresponding plans for sister ships. 30 illustrations. 2,800 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* April 11.

Gio Ansaldo e Co.—By E. Capel Cure. This article, describing in detail the largest private enterprise in Italy, opens with an historical outline of the above firm from the time of its birth to the present day. The firm had been established by Taylor and Prandi, but in less than seven years passed to Giovanni Ansaldo, who was chosen as the instrument in a vast scheme for making industrial and economic independence in Italy march parallel with her political resurrection. The works, free of all outside influence, are now in the hands of Commendatore Pio and Mario Perrone, having been left to them by their father, Commendatore Perrone, who died on June 9, 1908. It is of interest to note that in its four works the firm employs at the present time more than 10,000 hands, and they are able to construct and equip in their own shops and by purely Italian labor a Dreadnought from keel to truck. The headquarters of the firm are located at Sampierdarena, covering an area of 504,170 square feet. Here are the offices and management, shops for machinery, case hardening, big guns, heavy turning, milling machines, machine and turbine erecting, boilers, presses, turret erecting, locomotive and tenders adjusting and erecting, small and medium gun parts, blacksmith, hoops shrinking, stores and electric generating plant and transformers. The steel works at Cornigliano Ligue is composed of iron and steel foundries, Siemens-Martin furnaces, gas furnaces for thermal treatment, and gas producers, furnace for tempering guns, rolling mills, battery of planes for armor plate, heavy and medium machine tools, directors' offices, chemical laboratory and central power station. The Sestri Ponente shipyard occupies 1,033,337 square feet and the eastern section represents a modernized form of the old yard originally built by Giovanni Ansaldo himself. This part of the yard is complete in itself. A very interesting and unique method for launching is used, which has proven successful even with boats launched ready for sea. This is quite remarkable owing to the difficulties met with, especially in the depth of water and form of bottom. The natural complement of the shipyards at Sestri Ponente is the fitting-out yard in Genoa harbor. This is made the base for trials of the vessels of the mercantile marine, and the warships make a longer stay for purposes of fitting-out. Repairs to vessels of every type are also effected here. The total area on land is 161,459 square feet and the sheet of water forming the basin 861,114 square feet. Sheds and buildings cover an area, of land portion, of 80,729 square feet. Besides a detailed description of the various shops and the work that is carried on in them, the article includes a very interesting account of the labor conditions, showing the quiet and cordial relations between employers, managers and men. 61 illustrations. 5 plates. 25,000 words.—*The Engineer,* May 8.

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New Books for the Marine Engineer's Library

SHIPS OF THE UNITED STATES NAVY AND THEIR SPONSORS. 1797 TO 1903. Compiled by Edith Wallace Benham and Anne Martin Hall. Size, 6½ by 8½ inches. Pages, 227. Numerous illustrations. Privately printed. Price, $5.

This volume has been prepared primarily for the Society of Sponsors of the United States Navy, to bring together from widely scattered and inaccessible sources obtainable facts relating to the christening of United States naval vessels. No attempt is made to give complete biographies of individuals or complete histories of vessels, but brief biographical and historical notes, giving conspicuous facts, are included for the purposes of identification and for the inspiration of every reader with patriotic pride in the achievement of the navy. Orders or communications regarding this book should be addressed to Mrs. R. T. Hall, president, Society of Sponsors of the United States Navy, the Drexel, Sixty-third street and Overbrook avenue, Philadelphia, Pa.

MARINE BOILER MANAGEMENT AND CONSTRUCTION. Fourth edition. By C. E. Stromeyer, M. Inst. C. E. Size, 6 by 9 inches. Pages, 405. Illustrations, 463. New York and London, 1914: Longmans, Green & Company. Price, $4 and 12/6 net.

This book, which contains one of the most complete collections of information regarding the manufacture and management of marine boilers, is typical of the author, whose broad viewpoint, covering exhaustive investigations of every subject under discussion, makes the book not only of special interest but of the utmost value. For the information of manufacturers, the troubles to be expected from the use of defective materials are discussed, as well as the dangers to which a boiler is exposed after it leaves the manufacturer's hands. For the benefit of steam users, descriptions are given as to the processes of boiler construction and also scientific inquiries regarding fuels, corrosion and similar subjects. On account of the increasing use of wrought iron and steel, instead of copper, for steam pipes, a new chapter has been added on this subject which reviews all available experiments on the losses of pressure due to friction and to radiation, explains the methods of manufacture and discusses steam pipe explosions, of which about 200 have been reported by the Board of Trade as being due either to water hammer, to inelastic arrangement, or to bad material. The question of elasticity of pipe bends has necessitated the addition of a few mathematical remarks on curved beams and a comparison with experiments on full sized pipes. High-speed tool steel, oxy-acetylene and electric welding are other subjects brought out in the present edition. The last two chapters include Lloyd's Register and Board of Trade Boiler Rules.

THE DIESEL OR SLOW-COMBUSTION OIL ENGINE. By S. James Wells, Wh. Sc., and A. J. Wallis-Tayler, C. E. Size, 6 by 9 inches. Pages, 286. Illustrations, 130. London, 1914: Crosby, Lockwood and Son. Price, 7/6 net. New York, 1914: D. Van Nostrand Company. Price, $3 net.

This volume, treating specifically and fully of the design and construction of engines working on the slow-combustion system, has been prepared for use by draftsmen, students and designers. After a short historical account of the origin and development of the Diesel engine, the thermodynamics of the engine are taken up fully. The uses of the "pee-vee" and entropy diagrams are explained and problems are solved graphically by means of the heat chart. The chapter on oil fuels contains some very interesting and valuable information relating to the nature, composition and calorific values; methods of utilization; commercial value, method of transport and storage of liquid fuels. In addition to a study of balancing, some very useful notes are given relating to tests and upon the attention required when running an engine. Air compressors are dealt with thoroughly, starting from first principles. This is an important subject in Diesel engine design and one touched upon only lightly in most books on Diesel engines. The authors of this book, therefore, deserve particular credit for presenting it in such detail and in making it part of the design of the engine. Cylinders are discussed as regards strength, ratio of stroke to bore, piston speeds, and size for a given output. The formulæ for crankshafts, turning effort, based on indicator cards with hints on combining them easily, and loads on pistons and crankpins, make the book almost invaluable for designers and students. Valve gearing and inertia effects of same are dealt with in detail, showing the forces necessary to insure proper working of valves and the importance of setting injection valves, etc. Descriptions of all types of Diesel engines, both land and marine, are given and its future possibilities as a motive power in locomotives are considered. The authors have been very careful with the use of formulæ, etc., and those given are undoubtedly reliable, having been in most cases derived from first principles. An appendix (*A*) contains an abridgment of a considerable number of patents relating to the Diesel engine and an appendix (*B*) contains some useful formulæ, tables, etc. The authors have very successfully presented the subject, so that the book should be useful and invaluable to designers and students.

LLOYD'S REGISTER OF AMERICAN YACHTS, 1914. Size, 9 by 7 inches. Pages, 513. Colored plates, 49. New York, 1914: Lloyd's Register of Shipping. Price, $7.

The new edition of Lloyd's Register of American Yachts lists a total of 3,564 yachts, 544 yacht clubs, and 36 yachting associations or other organizations connected with the sport. The old schooner *America*, which by chance did not appear in the little book of 1874, being then a vessel of the United States Navy, is still in Lloyd's, almost alone in point of age, but with her are the three defenders of the Cup which she won—*Resolute, Defiance* and *Vanitie*. Another notable new yacht is the schooner *Katoura*, owned by Robert E. Tod, designed and built by the Herreshoffs to Lloyd's rules for the International racing classes and already spoken of as a possible challenger for the America Cup in the event of the victory of the challenging Shamrock IV.

The changes of this year are, first, the passing of many wooden yachts of the Burgess era; second, the addition of new cruising yachts of larger size propelled by gasoline (petrol) engines, and third, the very large number of small raised-deck cruisers, the family launch that is meeting with such well-deserved popularity on inland as well as coastal waters.

How many yacht clubs exist today within the limits of the States, Canada and the West Indies is a question that cannot be definitely answered; the records of Lloyd's show between six and seven hundred under the varying titles of yacht, launch, power boat and motor boat clubs; many of these, small and of recent origin, are difficult to locate, but the full particulars, including location, entrance fees and dues, names of officers and address of secretary, are given for 544 clubs. The color plates include, in addition to the various national ensigns and the Signal Code and Weather Bureau flags, the burgees of 587 clubs and associations and the private signals of 1,920 yachtsmen.

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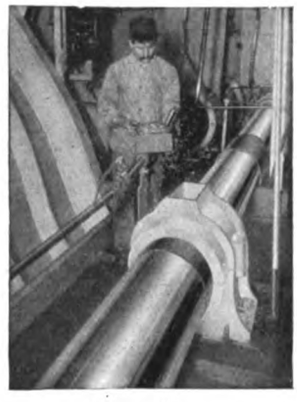
ENGINEERING SPECIALTIES

Lubrication of Tunnel Bearings

Mr. E. D. Edwards, chief engineer of the steamship *Bermudian* of the Quebec Steamship Company, plying between New York and Bermuda, has been using for the past fifteen years a method of lubricating tunnel bearings which he claims gives the best lubrication service with a minimum amount of attention and at the lowest possible cost. The lubricant used is Albany grease supplied by the Albany Lubricating Company, New York, and the method of lubricating the tunnel bearings is as follows:

The bearing caps are constructed with a large opening at the top about 8 by 5 inches and about 7 inches deep to the

Bearing Cap



Grease Box

shaft. In this opening is inserted a grease box made of brass or galvanized iron formed to fit the opening, with a lip at the top which supports the box in position and permits the bottom of the box, which is formed to the curvature of the shaft, to rest within 1/16 inch of the shaft. The bottom of the grease box is perforated with a number of 1/8-inch holes and the grease is cut up into small chunks and placed in the bearing boxes. As the temperature of the shaft when in

Section of Grease Box

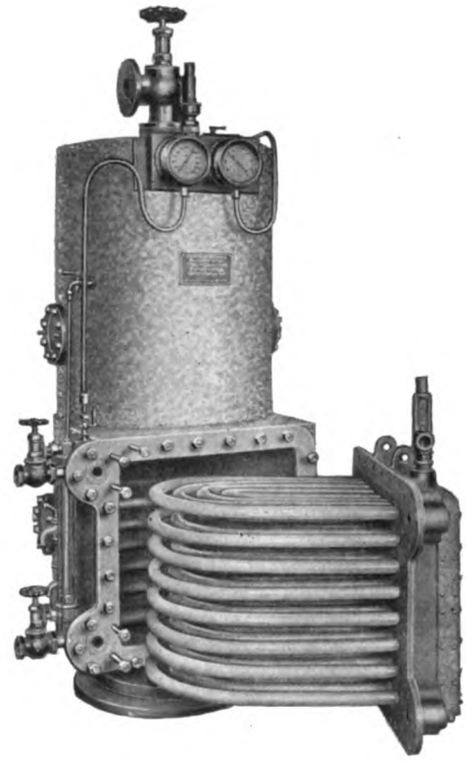
motion rises above the normal, it causes the grease in the bearing boxes to soften and work through the perforations to the shaft, lubricating the bearing and reducing the temperature of the shaft to normal. It is claimed that the grease which is used for this purpose will not soften and flow again into the bearing until the bearing temperature rises again, thus insuring practically automatic lubrication.

To make sure that a constant supply of grease is always on the bottom of the grease boxes, a wooden rod is kept in each box by means of which the grease is worked down by the oilers on their regular rounds. Each bearing box holds about two pounds of grease, and about forty pounds of grease are consumed in the tunnel bearings each trip, which lasts about forty or forty-five hours, according to weather conditions.

Schutte & Koerting Evaporators

The Schutte & Koerting Company, Philadelphia, Pa., has on the market a vertical navy type evaporator consisting essentially of an upper and lower body. The upper body is the vapor chamber and the lower body contains a nest of tubes or coils comprising the heating surface through which the steam is circulated. Each coil is arranged to thoroughly drain itself, all drainage finally being taken out through the bottom set of coils. This arrangement, it is claimed, eliminates the choking of the coils.

An important feature of this evaporator is the method of preventing priming. Priming is caused by the formation of large air bubbles and by the vapor holding water in suspension. Ordinarily, this can be overcome by the use of a



long vertical vapor pipe of large diameter, but the Schutte & Koerting evaporator has a special baffle plate arrangement in the vapor chamber which collects the water in suspension, thus eliminating, it is claimed, the possibility of priming.

According to the requirements, the lower body of the evaporator is of cast iron, or bronze, and the upper body, or vapor chamber, of sheet brass, copper, cast iron or steel. Particular care has been taken in the design of the fittings. When removing the tubes for cleaning, no steam joints need be broken and the tubes are so arranged that they may be easily scaled. The weight and space occupied by these evaporators have been reduced to a minimum, as is shown by the fact that an evaporator with a capacity of 20 tons per day is only 7 feet high, occupying a floor space 3 feet 10 inches by 3 feet 5 inches.

The Von Riegen Patent Firebridge Bar

The Von Riegen firebridge bar, illustrated, has been designed to improve the combustion of fuel in Scotch boilers and to do away with the troubles commonly experienced with the ordinary grate and bridge. The title "firebridge bar" has been given to this arrangement because when all the bars are placed in the grate they form the firebridge by means of their rear hook-shaped ends resting upon a thickened ledge or

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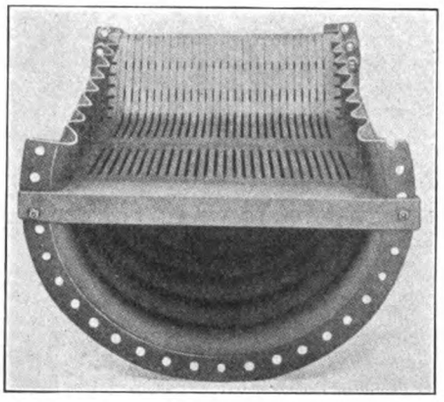
flange on a partition which closes the ash pit. The forward ends of the bars are freely suspended from cross-beams. Each firebar is provided on its rear upwardly bent end with lugs by means of which the bars mutually support each other. The lugs also form passages between the bars for the circulation of air. The partition which closes the ash pit toward



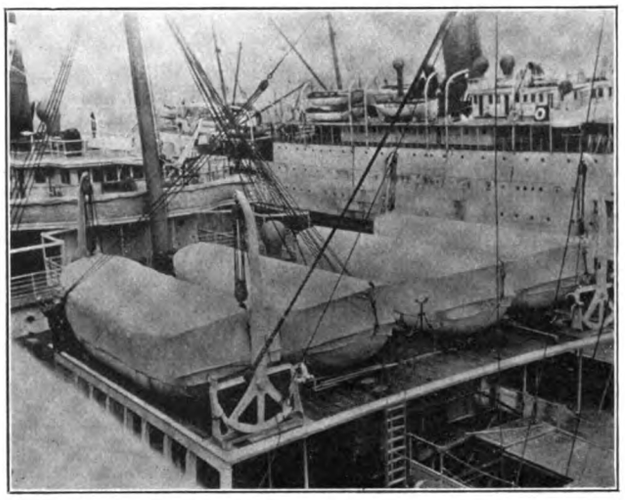
the rear consists of two parts with pieces laid in—an arrangement which facilitates varying the height of the firebridge according to the nature of the fuel used. In the lower part of this partition a hole with a small door is provided for purposes of cleaning. As shown by the illustration, all brick work is dispensed with, so that the bars can easily be placed in position, allowing speedy repairs. Another advantage is that the fires can be cleaned at sea in a comparatively short time, thus reducing fluctuations of steam pressures to a minimum. It is also claimed that clinker does not adhere to this structure as it does to brick work, and that the firebridge bar will not become choked up with slag and ashes.

The patents for the Von Riegen firebridge bar are controlled by Paul Pajewski, Hamburg 30, Eidelstedterweg 8, Germany.

New Arrangement of Lifeboats on the U. S. Transports

When the question of fitting out the United States transport ships with adequate lifeboats for all on board came up, the government called for demonstrations of apparatus and arrangements, and in October, 1912, utilized the transport *Kilpatrick* at Newport News for carrying out tests of the various types of boats and davits. As a result of these tests the Welin Marine Equipment Company, of Long Island City, N. Y., received an order for Lundin decked lifeboats with complete Welin davits and fittings, sufficient to carry 10,200 persons, which means about one hundred and seventy-six boats.

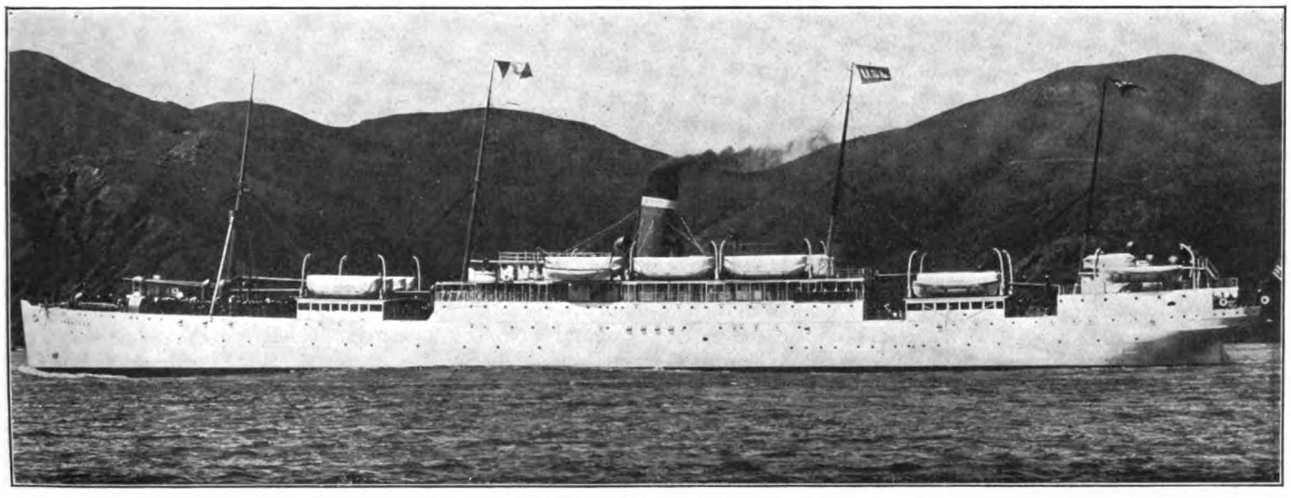
The *Kilpatrick* was the first of the fleet of nine United States army transport ships to be equipped with her new



Eight Lundin-Decked Lifeboats Nested on the Skids of the *Sheridan*

complement of lifeboats. She was on the Atlantic coast, and the work of installation was done at the Morse Dry Dock Company, Brooklyn, N. Y. The *Sheridan,* shown in Fig. 1, is the second, the work being done at the Union Iron Works, San Francisco, where the *Logan* is now being similarly fitted out. As now fitted, the *Sheridan* has a lifeboat capacity for 2,100 persons, and as her maximum capacity for passengers and crew is 2,069, she has an actual excess of thirty-one provided for in the boats and rafts.

The compactness with which these boats are stowed is shown in the view of the decked-over skids, built across the ship from rail to rail, just forward and aft of her bridge deck. On the forward one are stowed eight 28-foot Lundin decked lifeboats "nested" two deep, under two pairs of double-acting Welin quadrant davits. This one group of boats will safely carry 480 persons. As shown in Fig. 2 the davits reach inboard far enough to stow the boats on the inner tier as well as deposit them in the water well outside the side of the ship.



U. S. Army Transport *Sheridan*, With Her New Outfit of Small Boats

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An Economic Way to Handle Shipments of Long Iron Rods

The recent installation of a Shaw electric crane at the plant of the Bayonne Bolt & Nut Company, of Bayonne, N. J., is an important illustration of the manner in which one problem of handling material was solved by the application of a few small strands of wire. The Bayonne Bolt & Nut Company receives quantities of bar stock-iron rods about 20 feet in length, and ranging in diameter from ¼ inch upward. This raw material comes in gondola cars on the company's private switches. The unloading and stacking of the rods by hand was, however, a slow and expensive process.

In seeking a better way to do the work an electric crane and magnet was installed by the Shaw Electric Crane Company, of New York, and by wiring the rods together in bundles of approximately a dozen, it was possible for the magnet to make a clean lift, not merely of one bundle, but of a number of bundles up to its lifting capacity. With the crane and magnet, work can now be accomplished in a few minutes which under the old method took a gang of freight handlers hours to do, and the rods can be piled to a greater height than would have been economically possible by hand work.

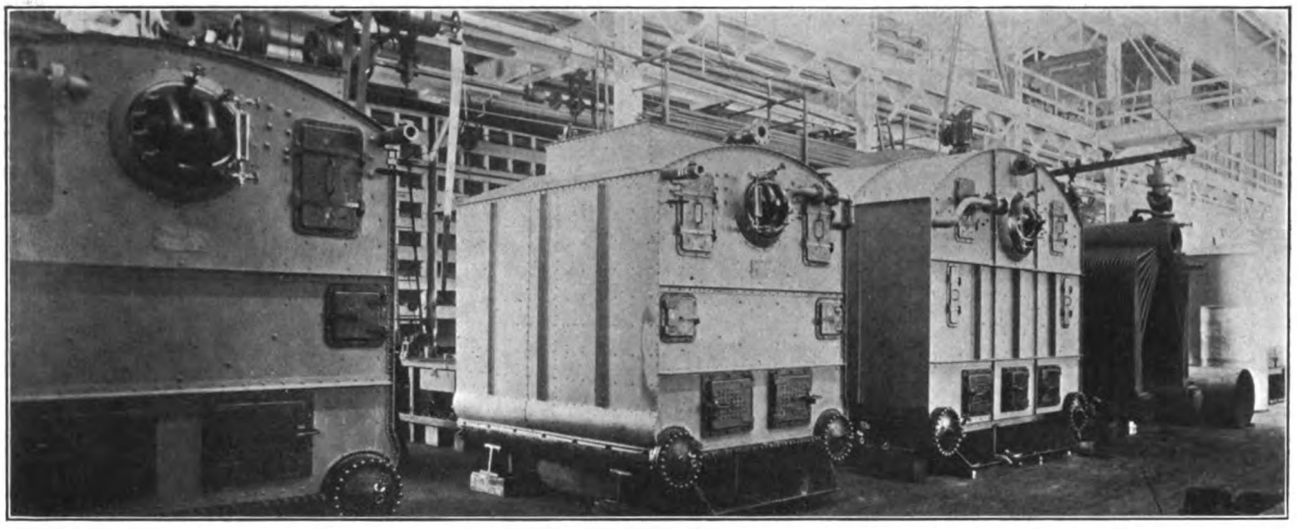
New Seabury Boilers

In the construction of the Seabury marine watertube boiler, manufactured by the Gas Engine and Power Company and Charles L. Seabury and Company, Consolidated, Morris Heights, New York City, four of which are shown in the course of construction in the accompanying illustration, the steam drum consists of a tested steel plate of 60,000 pounds tensile strength, rolled up and double riveted with bumped heads of tested material riveted in. The two mud drums are usually constructed of lap-welded steel tubing, having flanges riveted to each end, to which cast steel covers are secured by means of studs. The steam and mud drums are then accurately drilled with jigs for tube holes. The tubing, of which the greater portion of the heating surface consists, is of seamless drawn steel, expanded into the holes in the steam and mud drums, there being no screw joints subjected to the intense heat in the combustion chamber. The tubes are so bent and arranged as to leave ample passage for the gases, as well as to provide necessary baffling and allow for expansion and contraction.

Over the nests of tubes on both sides of the steam drum is located a feed water heater, through which the water passes before entering the drum. The heater is constructed of steel piping and malleable iron return bends, and between the heater and drum is interposed a check valve. The boiler is cased in a substantial sheet steel jacket, stiffened with angles and lined on the inside with magnesia and asbestos, except the ends of the combustion chambers, which are lined with fire brick. The casing is fitted with all necessary fire and cleaning doors.

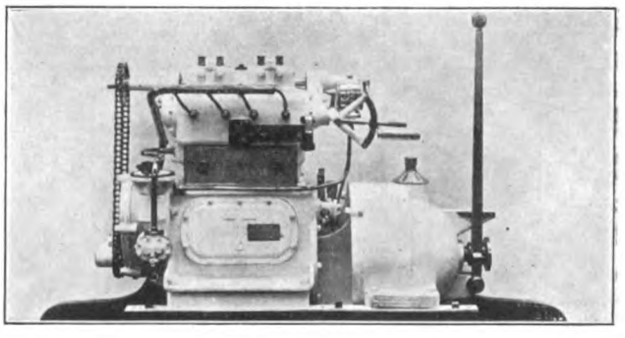
The shaking grates with which all Seabury (anthracite) coal burning boilers are equipped are an important feature in their design. They consist of square steel bars running lengthwise of the boiler, carried on cast iron bearers; these bars extend through the boiler front, where they can be conveniently shaken. Cast iron grate bars in sections are fitted, when it is desired to burn soft coal

Owing to its large combustion chamber the Seabury boiler is well adapted for the burning of fuel oil and any of the many successful systems now on the market can be readily applied.



New Thornycroft Marine Motor Type "T"

Messrs. John I. Thornycroft & Company, Limited, Southampton, recently exhibited at the aero and marine motor exhibition a new type kerosene (paraffin) and gasoline (petrol) motor which will be known as their "T" type. The new type has been placed on the market to meet the requirements of a moderate weight, compact four-cylinder high speed



motor, suitable for installing in fast craft up to 30 feet in length. The four cylinders, which are cast monobloc, are 3½-inch bore by 5½-inch stroke and the powers developed at about 1,100 revolutions per minute are 18 brake horsepower on kerosene (paraffin) and 22 brake horsepower on gasoline (petrol). Some special features in this new type are worthy of note; all the valve gear is enclosed by a casing over springs, etc., being instantaneously removable. A large crank-case door gives easy and ready access to the main bearings. Lubrication

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is on the trough system, the oil being fed to the troughs by means of a small gear pump. A large glass indicator is fitted in a prominent position, enabling the proper circulation of the oil to be readily seen. The reverse gear is of the epicyclic type, the ahead cone being combined with the flywheel, thus forming a single unit. This method is to be recommended, for when installing the difficulties of correct lining up are much reduced. The ignition is by high tension magneto. For running on kerosene (paraffin) a vaporizer of Messrs. Thornycroft's latest approved type is fitted and starting can be effected by running on gasoline (petrol) for about three minutes, after which the kerosene (paraffin) can be turned on. If, however, gasoline (petrol) is not available a blow lamp can be used to heat the vaporizer, and starting is effected from cold in about three minutes. The control is by a single lever, which operates on the governor.

Personal

THOMAS J. RILEY has been appointed chief engineer of the steamer *William* of the New Haven Towing Company, New Haven, Conn.

Mr. CARELS, one of the founders of the firm of Carels Freres, Diesel engine builders, died April 27th, at Ghent, Belgium, aged seventy-five.

LOUIS PURDY, formerly of the *Pawnee*, has been appointed chief engineer of the *Pentland*, plying between Lakes Superior and Erie in the lumber trade.

SAMUEL SHOEMAKER has become assistant to Stanley Raynes on the steamer *Oscar Barrett*, owned by the Barrett Tow Boat Company, Cairo, Ill.

DAVID A. BLACK has been appointed chief engineer of the steamer *City of Toledo* of the White Star Line, running between Port Huron and Detroit, Mich.

FRANK GOOD has been appointed chief engineer of the harbor tug *Alice Cooper*, owned by the Monongahela River Coal Company, and operated on the Ohio River.

WILLIAM F. SHANKS has been appointed by the owner, Captain Harry Davis, as chief engineer of the excursion steamer *Golden Fleece*, at Cairo, Ill., vice John Owing.

EDWARD HELLING, a well-known marine engineer of Paducah, Ky., is the guest of Horace Armstrong, chief engineer of the tug *Susie Hazard* at St. Louis, Mo.

GEORGE B. VAN ALLEN will be chief engineer and Captain Percy Wolfe will have charge of the *Robert Day*, of Albany, N. Y., which has been rebuilt for use on State work.

WILLIAM HURST has recently shipped as assistant engineer to E. Cropper on the steamer *Enterprise*, owned by the M. R. C. C. Co. and used for towing purposes in the Ohio River.

JAMES W. FRANCIS, chief engineer of the tug *Florence W.* of the J. P. Randerson Dredging Company, was seriously injured by being caught in the thrust-bearing coupling on the tug.

O. J. FISH, secretary of the American Shipbuilding Company, Cleveland, Ohio, has been elected treasurer to succeed Russel C. Whetmore, deceased. Mr. Fish will occupy both positions.

EDWARD C. MORGAN has recently been appointed engineer with Malvin C. Preston, chief engineer, on the steamer *Elm City*, of the Long Island Navigation Company, at West Haven, Conn.

JOSEPH P. BRADY, of Washington, D. C., is chief engineer of the steamer *General E. O. C. Ord*, used by the government for mine planting. George M. Crocke, of New York, is his first assistant.

PETER DIETZ has been appointed chief engineer of the steamer *Yosephee*, recently chartered by the government to work at Albany, N. Y. Captain Albert Hotaling will have charge of the steamer.

ARCHIBALD BRYCE, now chief engineer of the *Aquitania*, joined the Cunard Line as a junior engineer in 1884. Last year Mr. Bryce, who is a native of Liverpool, was chief engineer of the *Lusitania*.

ROBERT B. WALLACE, one of the best known marine engineers on the Great Lakes, has resigned as general manager of the American Shipbuilding Company, Cleveland, Ohio, a position which he has held since 1908.

CHIEF ENGINEER WILLIAM C. CLAFLIN and Captain George McCabe, formerly of the Albany Towing Company, have received appointments on the tug *Chester* for the J. P. Randerson Dredging Company, Albany, N. Y.

THE passenger steamer *Thomas S. Craig* has been converted into a towing vessel for runs between Albany and Parr Island and named after the captain in charge, M. W. Hill. The captain's son, Walter B. Hill, will be the engineer.

RICHARD WARD BAKER, identified with the Watson-Stillman Company, of Aldene, N. J., and New York City, since 1864, has just been paid fitting recognition for his fifty years of service in that company by the presentation of a handsome gift.

JOHN CAREY, formerly first assistant engineer of the steamer *C. W. Morse* of the Hudson Navigation Company, New York, has been appointed chief engineer of the *Kintch* of the Great Lakes Dredging and Dock Construction Company. Captain M. E. Fallon will be in charge of the *Kintch*.

ALFRED G. SMITH has been elected general manager of the American Shipbuilding Company, with headquarters at Cleveland, Ohio. Mr. Smith was general superintendent of the Chicago Shipbuilding Company for six years and a practicing naval architect for about the same length of time.

GEORGE T. CAHILL was recently transferred to the tug *George E. Lattimer* as chief engineer. In charge of Captain George Barnard, this tug made a trip to Palmyra, N. Y., for a fleet of pontoons and houseboats in charge of Captain Charles Scanlan, for the Great Lakes Construction Company.

NAVAL CONSTRUCTOR H. A. EVANS, a graduate of the Naval Academy at Annapolis of the class of '92, who, after completing his sea service, was sent to the University of Glasgow, Scotland, for a special course in shipbuilding and designing, has recently been elected vice-president and general manager of the Skinner Shipbuilding and Dry Dock Company, Baltimore, Md.

C. J. TENNESON has been appointed chief engineer of the steamer *Frederick Du Barry*, owned by the Potomac & Chesapeake Steamboat Company, Washington, D. C., to fill the vacancy caused by the death of Albert Geen, whose appointment to the position of chief engineer of this vessel was announced in our last issue.

B. O'DONNELL has been appointed chief engineer of the steamer *Angler*, plying on the Potomac River from Washington, D. C., to Riverview, Md. Mr. Dugan is assistant engineer on the *Angler*.

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SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

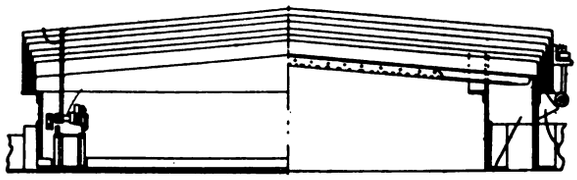
American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Millertown, N. Y.

1,093,159. TURBO SHIP-STEADYING DEVICE. ELIHU THOMSON, OF SWAMPSCOTT, MASS., ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

Claim 8.—A gyroscopic anti-rolling device for ships, comprising a vertical shaft turbo-generator having a condenser base and mounted to swing in a fore-and-aft plane, a tank in which said base is submerged, means for supplying said tank with cooling water, and a plate on said condenser base dividing said tank into two compartments on the plane of the axis on which the machine swings. Eleven claims.

1,072,611. WATERTIGHT HATCH FOR BOATS. WILLISON H. HAYES, OF TOLEDO, OHIO.

Claim 1.—A hatch cover comprising a series of collapsible sections adapted to be extended to cover hatch opening and drainage means for



the joints between adjacent sections permitting of the collapsing of same. Twelve claims.

1,094,005. LOAD-TRANSFER APPARATUS. THOMAS SPENCER MILLER, OF SOUTH ORANGE, N. J.

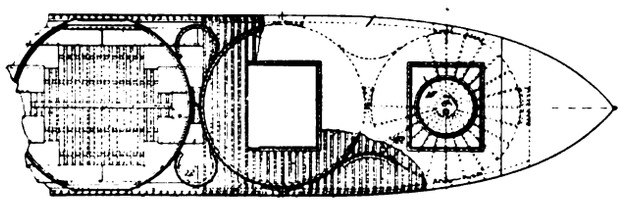
Claim 1.—In a load-transfer apparatus, a support, a swinging rope supported therefrom and having a rope guide, a combined hoisting and swinger rope guided by said guide, and a rope opposing the pull on the hoisting rope. Seventeen claims.

1,094,963. MECHANISM FOR FIRING TORPEDOES. THEODORUS S. BAILEY, OF QUINCY, MASS.

Claim 2.—A torpedo tube installation comprising a plurality of tubes having tube opening mechanism and firing mechanism associated therewith, in combination with a firing control device common to a plurality of the firing mechanisms and connections between the tube, opening mechanism and said firing conrtol device, such that the actuation of the tube opening mechanism automatically connects the firing control to the open tube; substantially as described. Ten claims.

1,085,086. TANK VESSEL. CHARLES P. M. JACK, OF NEW YORK, N. Y., ASSIGNOR TO THE INTEROCEAN TRANSPORT COMPANY, OF NEW YORK, N. Y., A CORPORATION OF SOUTH DAKOTA.

Claim 1.—A tank vessel comprising a hull, and a vertical tank forming a part of the structure of the vessel the sides of the tank being



formed by semi-circular bulkheads directly connected to the sides of the hull. Eight claims

1,090,923. LIFEBOAT. LAURITS OLUF LARSEN, OF PERTH AMBOY, N. J.

Claim 1.—In a collapsible lifeboat comprising longitudinal ribs and cross ribs adapted to interlock therewith, friction fingers carried by said longitudinal ribs for releasable engagement with said cross ribs, pins carried by said longitudinal ribs for releasable engagement with the terminations of said cross ribs and yieldable locking means carried by said longitudinal ribs for engagement with said pins to retain them in operative position. Two claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

18567/1912. PONTOON FOR LIFTING SUNKEN VESSELS. B. JOURAVLEFF, LIEUTENANT, MARINE ENGINEER CORPS, ST. PETERSBURG, RUSSIA.

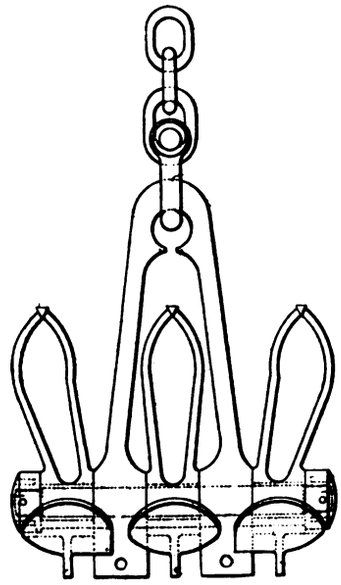
Relates to improved means for use in lifting sunken vessels, including a pontoon provided with a chamber permanently filled with air to give buoyancy, and adapted to be submerged by flooding and to be lowered towards the sunken vessel through the intermediary of guide ropes connected to the sunken vessel and wound around drums of pneumaitc winches fitted on the pontoon, which serve merely to wind up the guiding lines in lowering the pontoon.

21,409/1912. IMPROVEMENTS IN NAVIGATIONAL SOUNDING APPARATUS. KELVIN & JAMES WHITE, LIMITED, 16, 18 AND 20 CAMBRIDGE STREET, GLASGOW.

Navigational sounding apparatus comprises, according to this invention, a sheath or bell open for passage of water at one end, and a prepared tube open at both ends and resiliently enclosed in the sheath or bell, this tube being adapted on emersion of the bell to indicate by the action of water on its inner surface the height to which the water has risen in the bell around the tube, when immersed. A chemically coated tube, which in uses is open at both ends and which is closed till required for use by destructible capsules, is employed in the apparatus.

9,710/1913. IMPROVEMENTS IN STOCKLESS ANCHORS AND IN HOUSINGS THEREFOR. A. F. W. STAHLBERGER, OF 2 TAYLOR STREET, WHITECROOK, CLYDEBANK, DUMBARTONSHIRE.

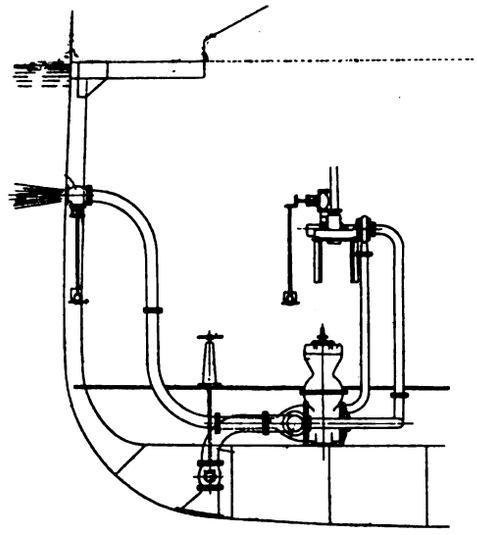
An improved stockless anchor is formed with a bifurcated or triangulated shank and provided with three similar main gripping fluke members, one pivoted between the bifurcations and one pivoted at either



side of the shank, which, at its upper end, is rounded to receive the usual shackle or link. A housing for use with the anchor has a curved base triangular in plan and flush with the ship's structure, and is provided with a curved cover-part, in which is a hawse hole and a fairlead.

3,176/1913. ASH EJECTORS FOR SHIPS. G. & J. WEIR, LTD., HOLM FOUNDRY, CATHCART, GLASGOW, AND J. PETERMOLLER.

Comprises an arrangement and construction of ash ejector, according to which a hopper, into which the ashes can be shoveled, is arranged so that the ashes can gravitate (*i. e.*, move solely by gravity) from this hopper into a discharge nozzle, through which they are driven by a



high-velocity water jet playing into and through this discharge nozzle into the eduction pipe, through which circulates, at a relatively low velocity, a quantity of water which fills the pipe, and is large compared with the quantity which constitutes the jet water. The delivery end of the nozzle is arranged co-axially within the eduction pipe.

27,296/1912. IMPROVED INSTALLATION FOR EJECTION OF ASHES FROM SHIPS. J. MEIKLE, OF MARYHILL, GLASGOW.

An installation for the ejection of ashes, etc., from ships, comprises one or more collectors each provided with a valve-controlled inlet passage leading from the sea and with a valve-controlled discharge passage leading to the sea at a point below the connection of the first passage with the sea, and a helical conveyor for conveying the ashes, etc., to the discharge passage of the collector.

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